PB85-214021

Superfund Record of Decision (EPA Region 6)
Tar Creek Site, Oklahoma, June 1984

(U.S.) Environmental Protection Agency
Washington, DC

6 Jun 84

U.S. Department of Commerce
National Technical Information Service
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Environmental Protection
Agency

Office of
Emergency and
Remedial Response

EPA/ROD/R06-84/004
June 1984

PB85-214021

EPA

Superfund Record of Decision:

Tar Creek Site, OK

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Tar Creek Site, OK

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16. ABSTRACT

Since November 1979, the Tar Creek watershed has received highly mineralized acid mine discharges from flooded underground lead-zinc mines of the Picher Field in Ottawa County, Oklahoma. Upon cessation of mining activities, drifts and shafts of the abandoned mine works began to flood. The acid water reacted with the surrounding rock causing many of the metals present to dissolve, resulting in high concentrations of zinc, lead and cadmium in the water. Discharge of these acid ground waters at the surface has resulted in degradation of Tar Creek and could eventually affect the Roubidoux aquifer which is the region's current water supply.

The cost-effective remedial alternative selected for this site includes: diversion and diking at two major inflow areas and possibly a third if it becomes an inflow site, the plugging of 66 Roubidoux aquifer wells, and implementation of a monitoring plan. The capital cost for diversion at the three sites and well plugging is estimated to be $4,000,000. The annual O&M costs are $5,000 for monitoring.

Key Words: Clean Water Act 404 Permits, Dredging, Filling, Wetlands, Ground Water Contamination, Ground Water Strategy, Environmental Impacts, Mining Wastes

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Record of Decision Tar Creek Site, OK Contaminated media: gw, sw, sediment Key contaminants: acidic waste water, metals, inorganics		

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ROD ISSUES ABSTRACT

Site: Tar Creek, Oklahoma

Region: VI

AA, OSWER
Briefing Date: April 6, 1984

SITE DESCRIPTION

Since November 1979, the Tar Creek watershed has received highly mineralized acid mine discharges from flooded underground lead-zinc mines of the Picher Field in Ottawa County, Oklahoma. Upon cessation of mining activities, drifts and shafts of the abandoned mine works began to flood. The acid water reacted with the surrounding rock causing many of the metals present to dissolve, resulting in high concentrations of zinc, lead and cadmium in the water. Discharge of these acid ground waters at the surface has resulted in degradation of Tar Creek and could eventually affect the Roubidoux aquifer which is the region's current water supply.

SELECTED ALTERNATIVE

The cost-effective remedial alternative selected for this site includes: diversion and diking at two major inflow areas and possibly a third if it becomes an inflow site, the plugging of 66 Roubidoux aquifer wells, and implementation of a monitoring plan. The capital cost for diversion at the three sites and well plugging is estimated to be $4,000,000. The annual O&M costs are $5,000 for monitoring.

ISSUES AND RESOLUTIONS	KEY WORDS
1. The proposed remedial actions, which involve diking and diverting inflow of surface water to affected geologic strata (via abandoned mine shafts), will affect surrounding wetlands and the channelization of Tar Creek. It is not necessary for EPA or the State to obtain a Section 404 permit since the COE was a member of the Tar Creek Task Force and has concurred on the remedy. However, the technical requirements of these permits must be met.	. Clean Water Act 404 Permits . Dredging . Filling . Wetlands
2. Superfund activities should be evaluated to ensure consistency with the draft Ground Water Strategy.	. Ground Water Contamination . Ground Water Strategy

ISSUES AND RESOLUTIONS	KEY WORDS
3. The environmental impacts on surface water organisms from proposed remedial actions must be assessed during the RI/FS and clearly addressed in the ROD. This is especially important at sites affected by mining wastes.	. Environmental Impacts . Mining Wastes

RECORD OF DECISION

REMEDIAL ALTERNATIVE SELECTION

SITE: Tar Creek/Picher Mine Field, Ottawa County, Oklahoma, and Cherokee County, Kansas

DOCUMENTS REVIEWED

I am approving this action based on the following documents describing the analyses of cost-effectiveness of remedial alternatives for the Tar Creek site:

- Tar Creek Site Investigation Report - Tar Creek Feasibility Report Summary of Remedial Alternative Selection

DESCRIPTION OF SELECTED REMEDY

- Diversion and diking at two major inflow areas in Kansas. A third area will also be diverted and diked if it becomes an inflow site in Oklahoma.
- The plugging of 66 Roubidoux aquifer wells, 26 of which are located in the Picher Mine Field area of Kansas.
- Implementation of a monitoring plan to assess effectiveness of diversion in mitigating discharge of acid mine water to the surface and well plugging in preventing contamination of the Roubidoux aquifer.

DECLARATIONS

Consistent with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and the National Contingency Plan (40 CFR part 300), I have determined that the plugging of abandoned Roubidoux wells and diversion of surface inflow away from the mine workings provides adequate protection of public health, welfare, and the environment. The States of Oklahoma and Kansas have been consulted and agree with the approved remedy.

In addition, I have determined the following conditions apply to the enactment of the selected remedy.

1. The action being taken is appropriate when balanced against the availability of Trust Fund monies for use at other sites.

2. The cost-effective remedy does comply with other environmental regulations.
3. Future remedial actions may be required if selected alternatives do not adequately mitigate the risk to human health.
4. Superfund assistance is necessary for Tar Creek because of the limitations associated with other possible resources for funding (see addendum 5).

Lee M Thomas

Lee M. Thomas
Assistant Administrator
Office of Solid Waste & Emergency Response

June 6, 1984
Date

SUMMARY OF REMEDIAL ALTERNATIVE SELECTION

TAR CREEK

SITE LOCATION AND DESCRIPTION

The Picher Field, located in Ottawa County, Oklahoma, and Cherokee County, Kansas, is one of the lead-zinc subregions which comprise the tri-state mining region of Oklahoma, Kansas, and Missouri. The field encompasses six square miles, and was one of the most productive lead-zinc mining districts in the United States. Figure 1 shows the mine workings in the main part of the Picher Field.

Surface features are characterized by numerous large tailing piles consisting primarily of limestone and chert. There are also several collapsed structures such as subsidence areas and mine shafts that have caved in.

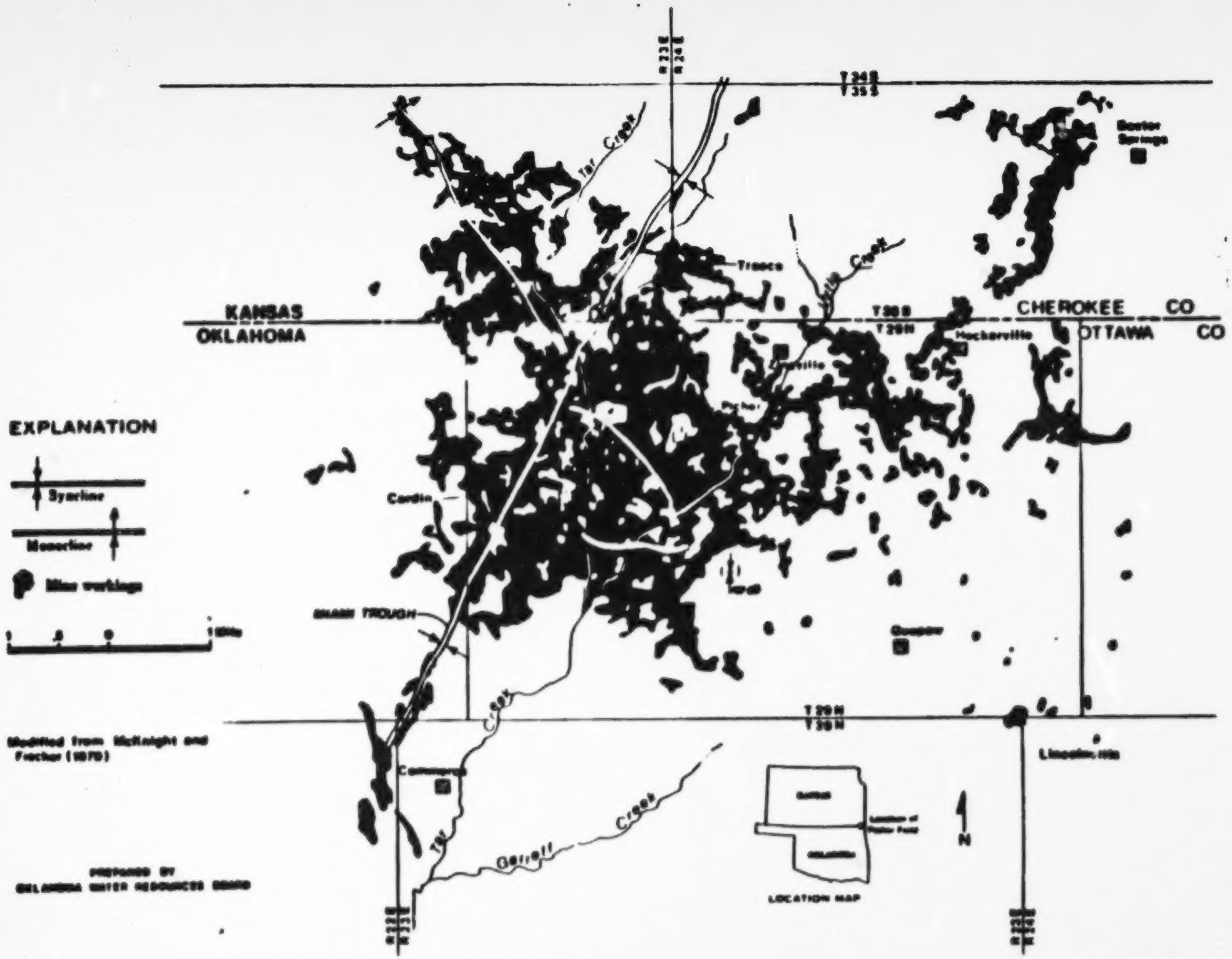
The Picher Field is situated on the west ridge of the Ozark Plateau province. The Ozark Plateau is a broad, low structured dome laying mainly in southern Missouri and northern Arkansas. However, the main part of the Picher Field is within the Central Lowland province. This province is characterized by a nearly flat, treeless prairie underlain by Pennsylvania shales.

The streams that traverse the mining field flow southward to the Neosho River. Elm Creek, on the western edge of the field, and Tar Creek and its main tributary, Lytle Creek, are the principal streams. A short distance east of the mining field is the Spring River, which is the major south-flowing tributary of the Neosho.

The principal communities within the Picher Field are Miami, Picher, Cardin, Quapaw, and Commerce. All these communities receive their drinking water from the Roubidoux aquifer, which is approximately 1,100 feet from the surface.

SITE HISTORY

Lead-zinc ores were first discovered in the Picher Field in 1901, with output of concentrates beginning in 1904. The main portion of the ore body was discovered in 1914, leading to a vast increase in ore production. Early mining was characterized by a multitude of small operators on 40 acre tracts, with each operator conducting mining, drilling, and milling operations. In the 1930's centralized milling began, leading to the consolidation of mining and milling operations.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Tar Creek
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KANSAS
OKLAHOMA
T 35 S
T 29 N
CHEROKEE CO
OTTAWA CO
Baxter Springs
Hockerville
Cardin
Picher
EXPLANATION
Syncline
Monocline
Mine workings
1 Mile
MIAMI TROUGH
Quapaw
Commerce
Tar
Garrett Creek
T 29 N
T 28 N
Lincolnville
N
LOCATION MAP
Modified from McKnight and Fischer (1970)
PREPARED BY
OKLAHOMA WATER RESOURCES BOARD

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Figure 1. Generalized location of the underground mine workings in the Picher Field, Oklahoma and Kansas.

Large scale mining activities ended in the mid 1960's and pumps were removed from the mines. By 1979, the majority of the underground mine workings were completely flooded and acid mine water began to discharge via abandoned or partially plugged mine shaft openings and boreholes.

Land ownership in Oklahoma was originally vested with the Quapaw Indian tribe. The Quapaw Indians were given 150 sections of land in southeastern Kansas and northeastern Oklahoma in 1833. However, an allotment plan approved in 1893-94 divided the reservation into 236 200-acre allotments and 231 40-acre allotments. Today ownership can be classified as private, or Indian restricted. Approximately 9,120 acres of Indian restricted lands are held by Indian allottees and (or) their heirs in the vicinity of the Picher Field.

Since November 1979, the Tar Creek watershed has received highly mineralized acid mine discharges from flooded underground lead-zinc mines of the Picher Field in Ottawa County, Oklahoma. The Oklahoma Water Resources Board (OWRB) in cooperation with the Tar Creek Task Force investigated the problem initially in 1980 and 1981. Additional study of specific areas was deemed necessary in order to fully assess the impact of acid mine water on the area's surface and ground water resources.

In October 1981, Tar Creek was listed among the sites on the National Priorities List under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA). A Cooperative Agreement, with a grant award of $435,368 to conduct Remedial Investigation/Feasibility Studies was signed between EPA and the Oklahoma State Department of Health on June 16, 1982. An Interagency Agreement was finalized with the Oklahoma Water Resources Board for $173,000 to conduct monitoring and sampling. Investigation work began in July 1982 and was completed in March 1983. The final report was approved the month thereafter. The Feasibility Study was initiated in May 1983 and completed in December 1983. The major findings of the investigation and feasibility reports are discussed in the section titled "Current Site Status."

CURRENT SITE STATUS

As with many underground mines in the area, continual inflow of ground water during mining posed a problem. Inflows were controlled by the installation of large capacity pumps. However, upon cessation of mining activities, drifts and shafts of the abandoned workings began to flood. Pyrite-rich wastes in the Boone formation were being oxidized by exposure to the oxygen-rich atmosphere while mining was occurring. Upon flooding, these oxidized sulfides readily dissolved into the surrounding ground water producing acid mine water. The acid water reacted with the surrounding rock causing many of the metals present to dissolve, resulting in a water with high concentrations of zinc, lead and cadmium. These are pollutants and contaminants and are listed hazardous substances under 101(14) of CERCLA. The concentration of these three metals, as well as iron, greatly exceed drinking water standards as shown in Table 1.

Discharge of these acid ground waters at the surface has resulted in degradation of Tar Creek and could eventually affect other major water resources of the area. Of potentially greater importance is the impact of acid mine water on the underlying Roubidoux aquifer. The contamination of the Roubidoux on a large scale would result in the loss of current municipal water supplies for much of the region.

The Tar Creek Investigation was developed to assess the health and environmental impacts of acid mine drainage on potential ground water and surface water receptors. Of foremost concern are the impacts to the area's drinking water sources: Grand Lake and the Roubidoux aquifer.

The following is a separate discussion on each of the critical pathways for migration.

Surface Water Impacts

Tar Creek is the principal drainage system in the Picher Field. With its headwaters in Cherokee County, Kansas, Tar Creek flows southerly through the field between Picher and Cardin, passing Commerce and Miami on the east, to its confluence with the Neosho River, one of two major rivers in northeastern Oklahoma. Tar Creek is a small ephemeral stream characterized by standing pools. Along with its major tributary Lytle Creek, Tar Creek drains approximately 53 square miles of area.

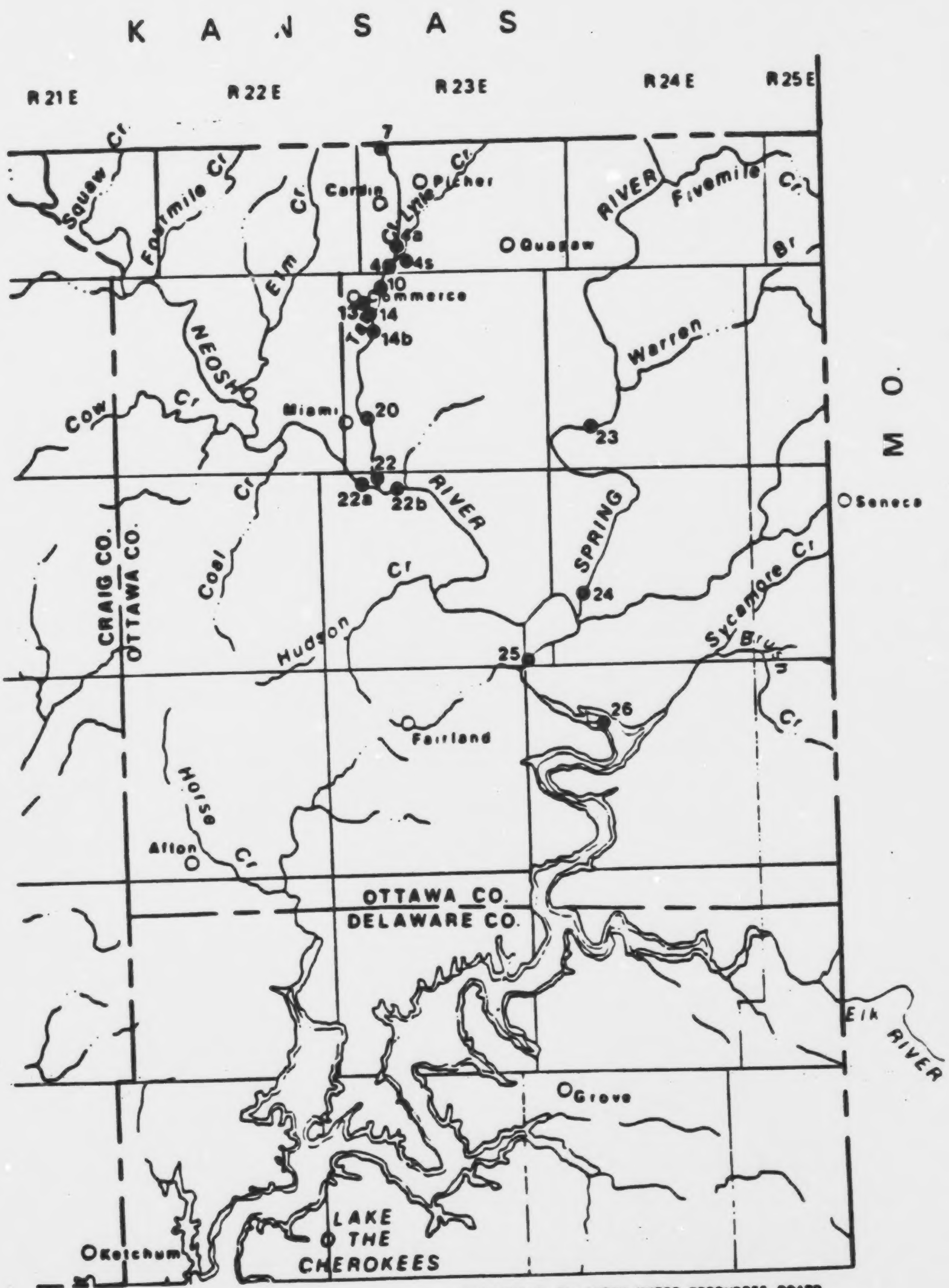
The primary discharge points for acid mine water into the Tar Creek watershed are sites 4s and 14 (Figure 2). Site 4s is intermitent and discharges at an average flow of 1.04 cfs when flowing. Site 14 discharges all year long at an average flow of 0.31 cfs. Typical concentrations of heavy metals discharging from the streams are shown in Table 2. Because of the low flow velocities at most times of the year, and the low buffering capacity of Tar Creek, the impact from acid mine water is severe. Hence Tar Creek is characterized as having high concentrations of heavy metals, high hardness, and low pH. Tar Creek has had a pH of 2.9 as far downstream as Miami.

As exhibited in Table 2, the chronic water quality criteria for several heavy metals is exceeded for all parameters above and below the acid mine water discharge points. There is, however, a significant increase in heavy metal loadings (and a decrease

Table 1. Example of ground water quality data at the surface and bottom of the Admirality No. 4 mine shaft within the Boone foundation.

Parameter	Surface Concentration	Bottom Concentration	Drinking Water Standard °
Ph (SU)	5.8	5.4	6.5 - 8.5
Cadmium (ug/L)	2	82	10
Iron (ug/L)	72,000	277,000	300
Lead (ug/L)	20	80	50
Zinc (ug/L)	60,000	331,000	5,000

° Primary and secondary drinking water standards


KANSAS
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R23E
R24E
R25E
7
Squaw Cr
Fourmile Cr
Elm Cr
Cardin
Picher
Lytle Cr
Tar Cr
4a
4
4s
Quapaw
RIVER
Fivemile Cr
Br
10
Commerce
13
14
14b
NEOSHO
Warren
M O.
Cow Cr
Miami
20
23
22
22a
22b
RIVER
Seneca
Coal Cr
CRAIG CO.
OTTAWA CO.
SPRING
24
Cr
Hudson
Sycamore Cr
Brush Cr
25
26
Fairland
Horse Cr
Afton
OTTAWA CO.
DELAWARE CO.
Elk RIVER
Grove
LAKE O THE CHEROKEES
Ketchum

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Figure 2. Location of sample sites.

Table 2. Statistical summary of water quality data for mine discharge sites (1980-82).

Site * Number	Mean Concentration	Maximum Concentration	Water Quality Criteria	
			Acute	Chronic
	pH (SU)			
4a	6.2	5.2	-	-
4	5.7	3.9		
10	5.7	3.3		
14b	4.1	3.6		
20	5.4	2.9		
22	6.5	6.0		
	Iron (ug/L)			
4a	12,020	96,000	-	-
4	53,751	290,000		
10	27,137	162,000		
14b	53,450	129,000		
20	8,853	52,000		
22	1,278	2,890		
	Zinc (ug/L)			
4a	27,398	80,000	320	47
4	38,644	141,000		
10	37,247	151,000		
15b	87,250	137,000		
20	21,333	104,000		
22	7,582	14,200		

Table 2. (Continuation)

Site * Number	Mean Concentration	Maximum Concentration	Water Quality Criteria Acute	 Chronic
	Cadmium (ug/L)			
4a	24.0	59	3.0	0.025
4	56.0	260		
10	32.0	82		
14b	43.0	69		
20	18.6	63		
22	4.0	11		
	Lead (ug/L)			
4a	2.0	49		
4	171.0	1,920		
10	92.0	1,090		
14b	26.7	47		
20	33.0	196		
22	20.0	20		

* Site 4a is upstream of discharge point; 4 is a mine discharge site; Site 10 is approximately 3 miles downstream from Site 4; Site 14 is 1/2 mile below discharge point 14; Site 20 is 10 miles below discharge point and near Miami; Site 22 is at the Tar Creek-Neosho River confluence.

in pH) downstream from the acid mine discharge points at site 4s and 14 resulting in severe stress to the aquatic community of Tar Creek. Studies conducted by the Tar Creek Task Force Subcommittee on Environmental Effects found no fish and only a few benthic macroinvertebrates surviving in Tar Creek.

Tar Creek is not used for a drinking water source. The greatest threat to human health along Tar Creek comes from possible dermal exposure to mine water from direct contact. Local residents use Tar Creek for recreational purposes including swimming.

The remedial investigation showed that Tar Creek currently has no significant impact on Grand Lake because when Tar Creek waters flow into Grand Lake, most of the heavy metals precipitate out of the water and into the Tar Creek and Neosho River stream sediments. The primary location where this phenonmenon occurs is at the Tar Creek and Neosho River confluence. With the Neosho River having flow capacities approximately 500 times greater than that of Tar Creek plus much greater buffering capacity, the acid mine water dilutes quickly and the heavy metals precipitate out. Inspection of water quality data at site 22b and data from heavy metal loadings in the sediments confirms these predictions.

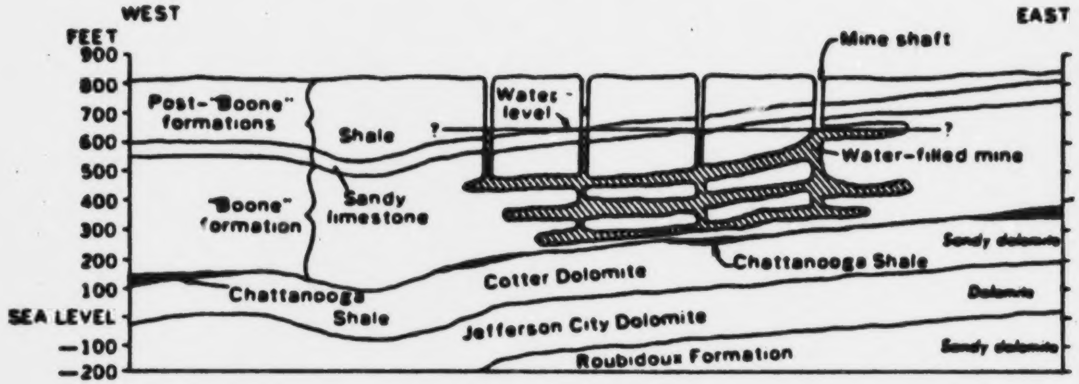
Ground Water Impacts

There are two possible pathways for migration of acid water from the Boone Formation into the Roubidoux (Figure 3). These pathways are: natural flow through intervening strata and flow through abandoned Roubidoux wells. Therefore, the goal of the ground water portion of the investigation was to assess the potential for migration via these pathways.

To assess the potential for acid mine drainage to flow under natural conditions from the Boone into the Roubidoux, hydraulic conductivity studies were done on cores from the intervening rock formations. The findings revealed very low permeabilities of 3.1×10^{-7} and 9.6×10^{-9} cm/sec, for the Cotter and Jefferson City dolomites, respectively.

In addition to the low permeabilities, a self plugging mechanism caused by chemical precipitation is thought to impede natural flow. On the same cores in which permeability studies were conducted, mine water was introduced at a mixture of 1:2 and 1:20 mine water to Roubidoux water. In the subsequent permeability tests, there was a reduction in core permeabilities of 72% and 67% respectively.

Some potential exists for contamination of the Roubidoux by natural flows if fractures are interconnected from the Boone down through the Cotter and Jefferson City formations and into the Roubidoux. It is unlikely that any interconnections span the entire 300-400 ft. distance between the Boone and the Roubidoux.



WEST
EAST
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SEA LEVEL
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Post-"Boone" formations
Shale
?
Water - level
Mine shaft
?
Water-filled mine
"Boone" formation
Sandy limestone
Sandy dolomite
Chattanooga Shale
Cotter Dolomite
Chattanooga Shale
Dolomite
Jefferson City Dolomite
Roubidoux Formation
Sandy dolomite

Figure 3. Generalized geologic section showing the location of the water filled mines. (Source: Playton, 1980)

Another mechanism for cross-contamination between the Boone and Roubidoux is abandoned wells. These wells provide direct access for mine water to migrate into the Roubidoux. The USGS conducted studies on two of the abandoned wells and showed that water was flowing downward. Sixty-six wells have been identified that extend from the surface into the drinking water aquifer. A possibility exists that more abandoned wells could be discovered in the future. If this occurs, additional funds would have to be requested in order to plug them.

Unlike the acute surface water problem, the Roubidoux aquifer is still a safe drinking water supply. Five communities (Miami, Picher, Cardin, Commerce and Quapaw) and a few rural water districts, with a total population of approximately 21,000, receive their drinking water from the Roubidoux aquifer. Most of the historical data on drinking water quality of the affected community wells indicate no degradation to date. The exception is the city wells serving Quapaw. At this location, two wells were abandoned because of mine water influx. Contamination is attributed to either casing failure or migration of mine water from nearby abandoned wells.

Other Environmental and Public Health Findings:

- Water distributed by the public water supplies and rural water districts of the Tar Creek area is safe to drink.
- The Neosho River, Spring River and Grand Lake can be safely used as a raw water source for public water supplies.
- The fish fillet samples indicate fish from the mouth of Tar Creek, Neosho River, Spring River and Grand Lake are safe for human consumption.
- No significant concentrations of toxic metals or radiation were observed in the particulate air samples collected at Picher.
- Effects on the fish community diminish rapidly, once waters enter the Neosho River.
- Metals found in the fish indicate that biomagnification is not significant in the fish community of Grand Lake.
- Although Tar Creek provides a concentrated source of metals, the head waters of the Neosho and Spring Rivers also contribute large quantities of metals.
- Sediments provide an effective long-term sink for metals and should effectively remove them from most biological processes.

- The Neosho River has received little impact from acid mine drainage into Tar Creek other than aesthetic alteration at the Tar Creek confluence.
- At current spring flows, all mine water will be displaced in 60 to 100 years.
- There is an estimated 76,000 acre feet of heavy metal laden mine water in the flooded underground mines.
- Mine waters are being introduced into the Roubidoux via abandoned wells.
- Although some contamination of heavy metals are provided by the tailings piles the overall quantity is insignificant compared to loading rates from the springs.

ENFORCEMENT

A meeting was held with the potentially responsible parties on January 16, 1984, to determine willingness to participate in design/construction activities. None of the companies provided assurances that they would participate in funding cleanup at that time. The companies were asked to negotiate among themselves and reply as to their intentions by February 16, 1984, and they did not formally respond. The parties have been informed that the Agency will proceed with the ROD and they will have 30 days following its signature to agree on a cleanup.

ALTERNATIVES EVALUATION

The objectives for cleanup at the Tar Creek site were to mitigate the potential threat to public health and the environment by preventing contamination of the Roubidoux and by minimizing toxic releases damage to Tar Creek. Two of the seven alternatives initially selected for evaluation addressed both cleanup objectives and would accelerate the improvement at ground water quality in the Boone formation. These remedial options were:

- _In situ_ treatment of mine water
- Collection and treatment of mine water

Both alternatives were eliminated from detailed analysis because they were excessively expensive. Long-term pumping and treatment of ground water from the Tar Creek area would be expensive and imprecise. Present value capital and operation and maintenance costs were estimated to approach $30 million. This option is ineffective because long-term pumping would not assure significantly less contaminated ground water.

The following five alternatives were selected for further evaluation. Each alternative was evaluated on the basis of effectiveness, durability, reliability, implementability and cost.

- No action
- Plug 66 Roubidoux wells
- Surface diversion
- Alternative drinking water supplies
- Surface discharge treatment

1. No-Action

The no-action alternative was evaluated for the purpose of assessing the potential for the system to recover under natural conditions with no outside influence. In a study completed in the investigation phase, 76,000 acre feet of contaminated water were estimated to exist in the mines. Given this quantity and taking into account the inflows and outflows of the system, it is estimated that 60 to 100 years must elapse before the acid mine water is replaced with relatively uncontaminated water. Furthermore, if Darcy's equation* is used to calculate the time necessary for mine water to traverse the vertical distance from the Boone to the Roubidoux, then approximately 15,000 to 25,000 years would be required. Meanwhile the mines should have flushed several times causing minimal long-term impacts to the Roubidoux. However, the abandoned wells are the critical pathways for migration and not the natural flow system. With the wells providing a conduit for flow, significant quantities of mine water could be introduced into the Roubidoux aquifer in relatively short periods of time.

From a surface water aspect, the acceptance of the no-action alternative means continued environmental damage to Tar Creek since 60-100 years will be required to flush the mines. For these reasons and those given in regards to ground water, the no-action alternative is unacceptable as a remedial solution.

* The use of Darcy's equation oversimplifies the system and is used only as a basis for an estimate. Not considered in the equation are dispersion and diffusion effects and effects of secondary porosity. The latter characteristic will greatly enhance migration if fractures are interconnected.

2. Plug 66 Roubidoux Wells

The well plugging program would consist of clearing the well holes of obstructions and setting an acid resistant cement plug from bottom to top (Figure 4) in sixty-six abandoned Roubidoux wells in Kansas and Oklahoma (see Figures 5 and 6 for locations). It is projected that construction costs will vary from $10,000 to $25,000 per well depending upon the difficulty in clearing each well. The total capital costs, including design, contingencies, and administrative costs, are $1,951,900 with no associated O&M costs.

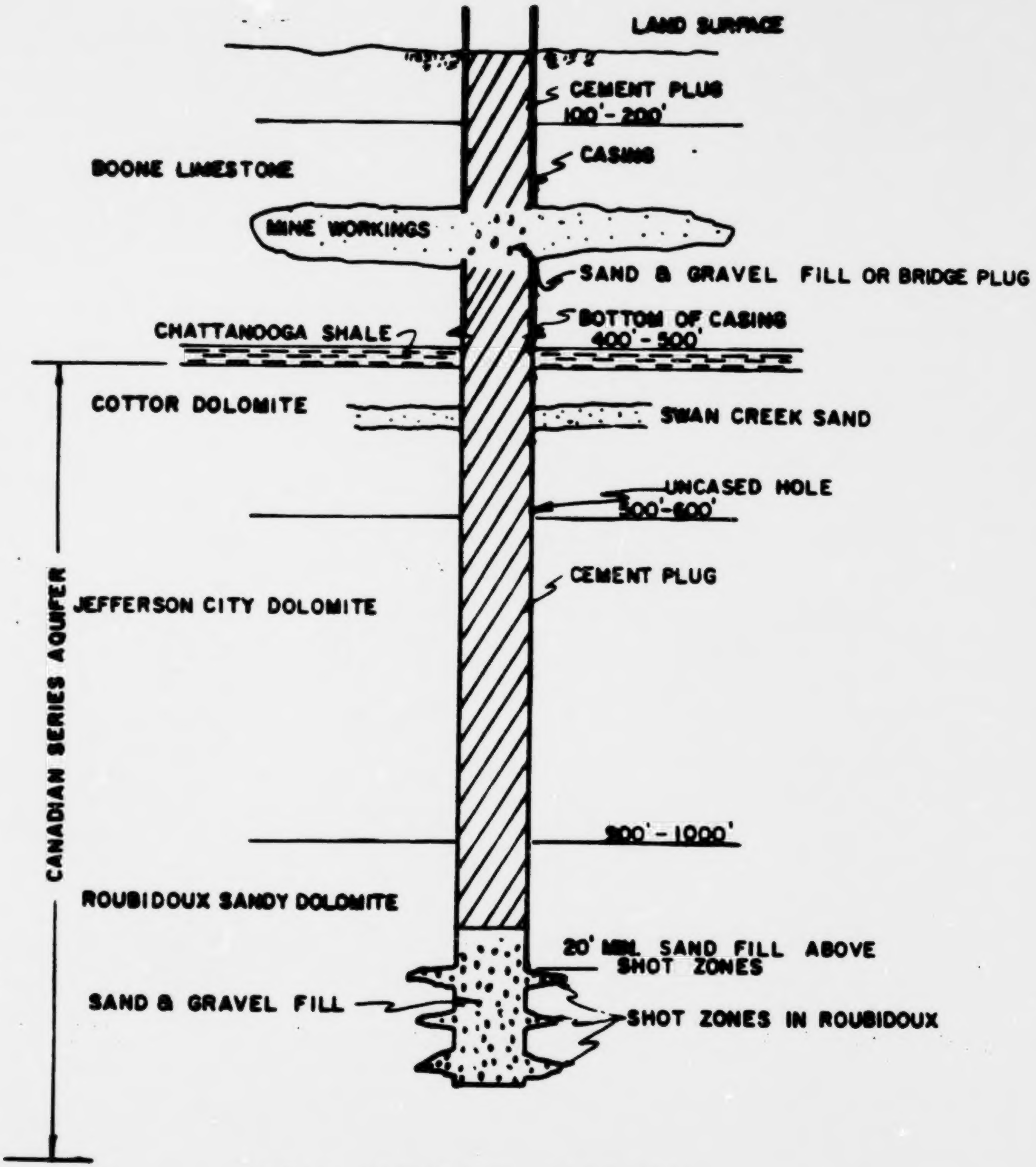
The well plugging program will not completely mitigate all threats to the Roubidoux aquifer. There are several ways that the Boone may contaminate the Roubidoux (as outlined in the Ground Water Impacts Section) including: fractures, unknown abandoned wells and natural flow. There is also a slight potential that some of the identified abandoned Roubidoux wells may be technically difficult or impossible to plug. If additional abandoned Roubidoux wells are located, additional funds would be required in order to plug them. Therefore, implementation of a monitoring program is recommended to detect trends in water quality of the Roubidoux. The detailed plans for the Roubidoux monitoring program are given in Addendum 4.

3. Surface Diversion

There are 600 mine shafts and collapse depressions within the study area each providing avenues for inflow of surface water into the mines. Total inflow is estimated to be 5,000 acre-feet per year. Once water has entered the mines, it acidifies and flows out of springs into Tar Creek further downstream. Surface discharge is estimated to be 1,000 acre-feet per year. The remainder of the inflow is believed to be removed from the system via lateral ground water flow in the Boone. Inflow points were ranked in the feasibility study to determine those providing significant inflow reduction and the cost effectiveness of plugging or diverting water from these areas as shown in Table 3.

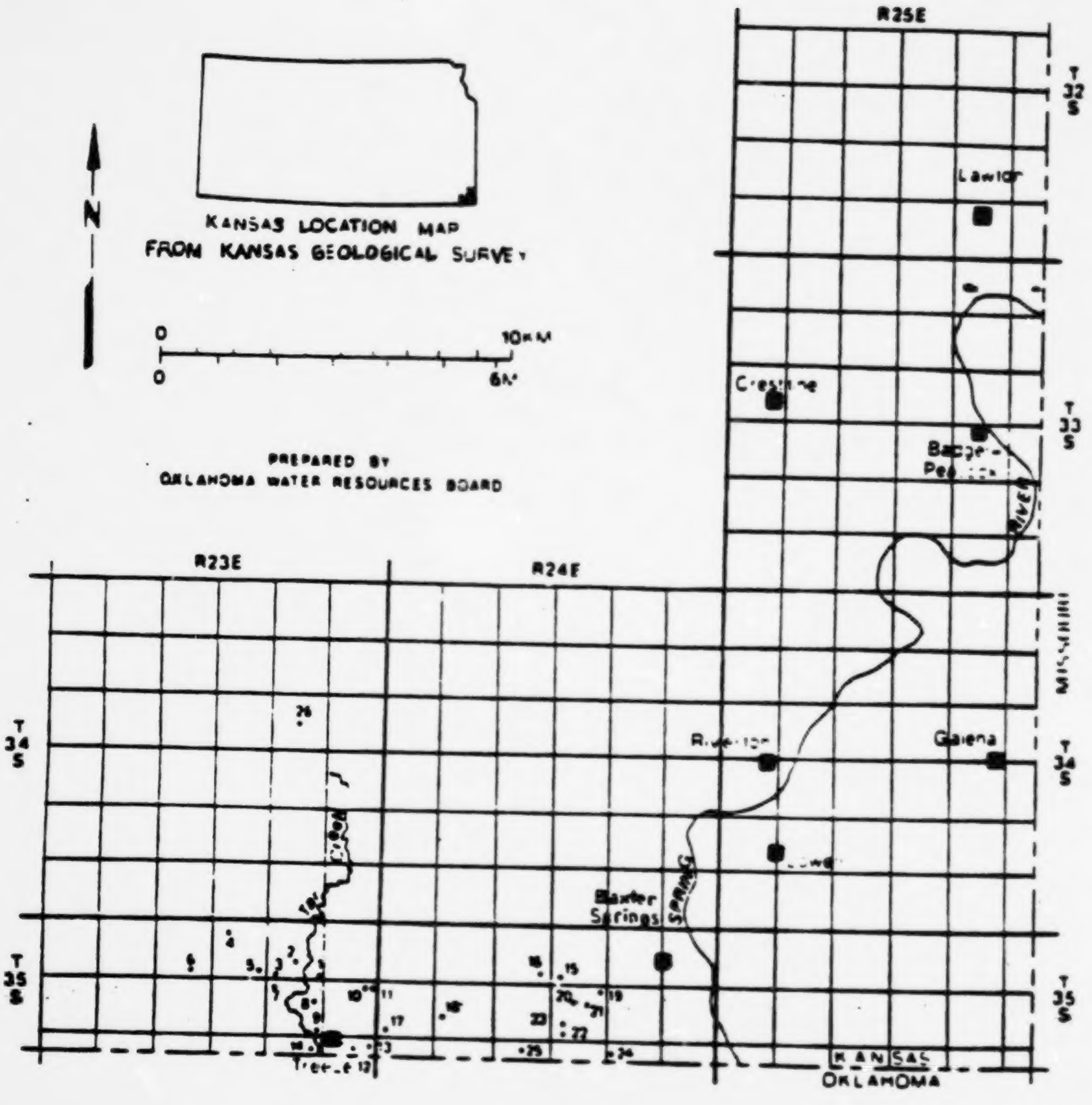
The hydraulics of the mine system are such that water entering the mines at sites K-1 and K-2 in Kansas flow out of springs and into Tar Creek downgradient in Oklahoma. Approximately 3,800 acre-feet per year flows into these sites. The main inflow point is K-1 (Muncie) which drains 4.52 sq. mi. and provides 2800 acre-feet of water to the mines in a year. The next priority area is K-2 (Big John) which is responsible for 1,000 acre-feet of the total surface water entering the mines each year.

Diversion work at K-1 and K-2 will significantly reduce the inflow and cause ground water levels to recede. If ground water levels drop below the present static water level at site 0-3, then it too will become an inflow point and may require diking and diversion work.


LAND SURFACE
CEMENT PLUG
100'-200'
BOONE LIMESTONE
CASING
MINE WORKINGS
SAND & GRAVEL FILL OR BRIDGE PLUG
CHATTANOOGA SHALE
BOTTOM OF CASING
400'-500'
COTTOR DOLOMITE
SWAN CREEK SAND
UNCASED HOLE
500'-600'
CEMENT PLUG
JEFFERSON CITY DOLOMITE
CANADIAN SERIES AQUIFER
900'-1000'
ROUBIDOUX SANDY DOLOMITE
20' MIN. SAND FILL ABOVE SHOT ZONES
SAND & GRAVEL FILL
SHOT ZONES IN ROUBIDOUX

WELL PLUGGING DIAGRAM

FIGURE 4.


KANSAS LOCATION MAP
FROM KANSAS GEOLOGICAL SURVEY
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Crestline
Galena
Riverton
Baxter Springs
SPRING
RIVER
TAR
CREEK
Treece
KANSAS
OKLAHOMA
MISSOURI

Figure 5. Location of Abandoned Wells in Kansas.

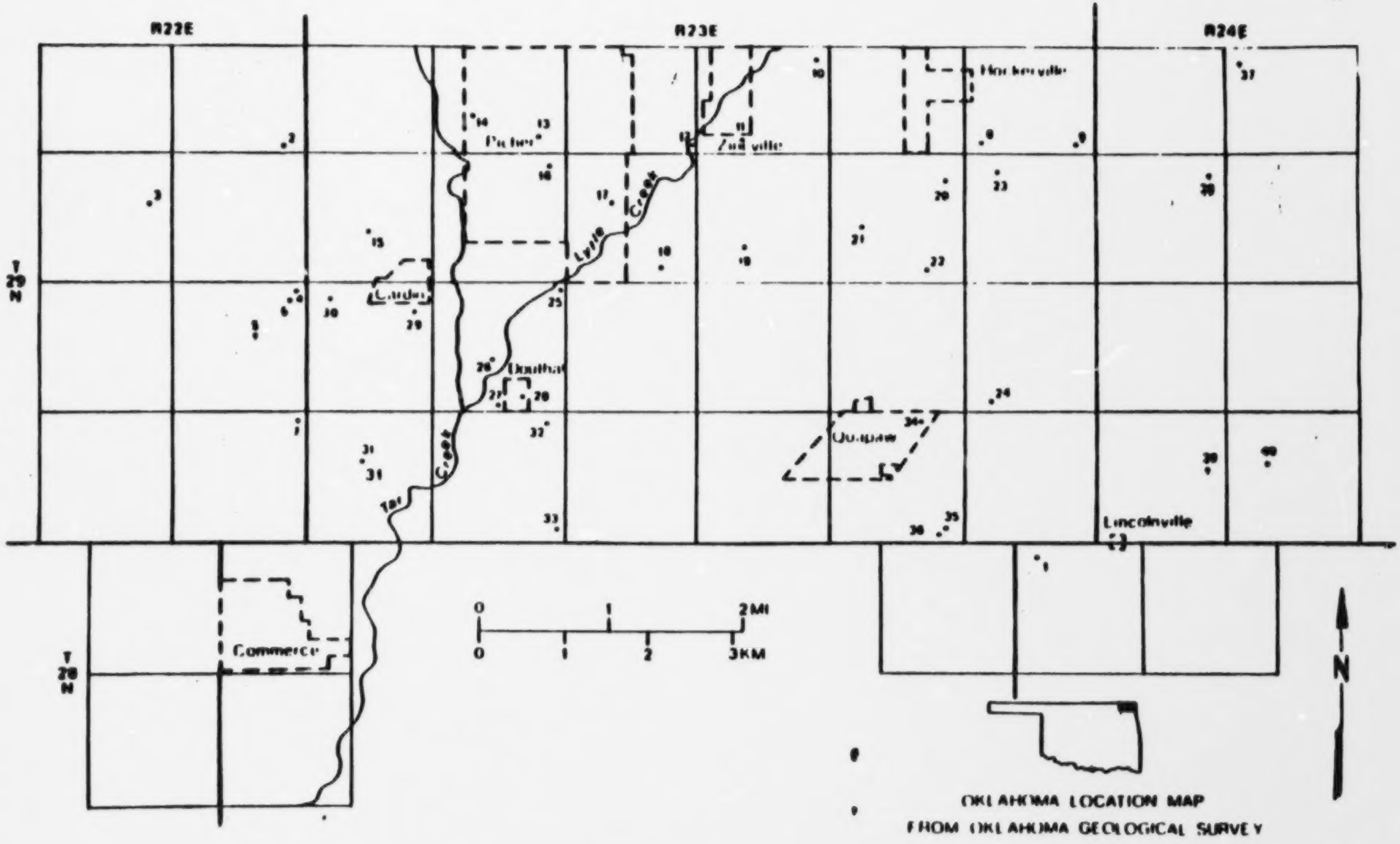

R22E
R23E
R24E
T 29 N
T 28 N
Picher
Cardin
Douthat
Zincville
Hockerville
Quapaw
Lincolnville
Commerce
Tar Creek
Lytle Creek
0
1
2MI
0
1
2
3KM
N
OKLAHOMA LOCATION MAP
FROM OKLAHOMA GEOLOGICAL SURVEY

Figure 6. Location of Abandoned Wells in Oklahoma.

PREPARED BY
OKLAHOMA WATER RESOURCES BOARD

TABLE 3

Diversion of Inflow Sites

Category	Site Numbers	Description	Percent Surface Inflow	Cost	Reason for Action or No Action
1.	K-1	Muncie	38	$ 700,000	• Low cost and good benefits
	K-2	Big John	34	150,000	• Low cost and good benefits
	O-3	Admiralty	See Note 2	850,000	• Low cost and good benefits
2.	O-5 thru O-18,		3	119,000	• Administrative complexity, long-term to impleme
	K-8,				• Administrative difficulties
3.	O-4	Commerce Area	5	1,000,000	• Increased flooding potential
4.	-	Other 588 small areas of subsidence	17	3,673,000	• High costs giving minimal benefit

NOTE: 1. Direct rainfall into the subsidence areas contribute 3 percent of the inflow.

2. Currently there is no inflow, however, inflow is predicted after the other diversion works are completed.

The O-4 area diversion work west of Commerce was also excluded. The flood assessment indicates the work would increase the flood stage to levels threatening residents of Commerce. Consequently, the 5 percent reduction of inflow and $1,000,000 cost did not merit the increased flood hazard.

The remaining 588 acres of subsidence were too costly in relation to the amount of inflow reduced. The proposed diversion projects are expected to reduce 75 percent of the inflow or approximately 3,000 acre-feet per year which is expected to stop the current 1,000 acre-feet per year outflow.

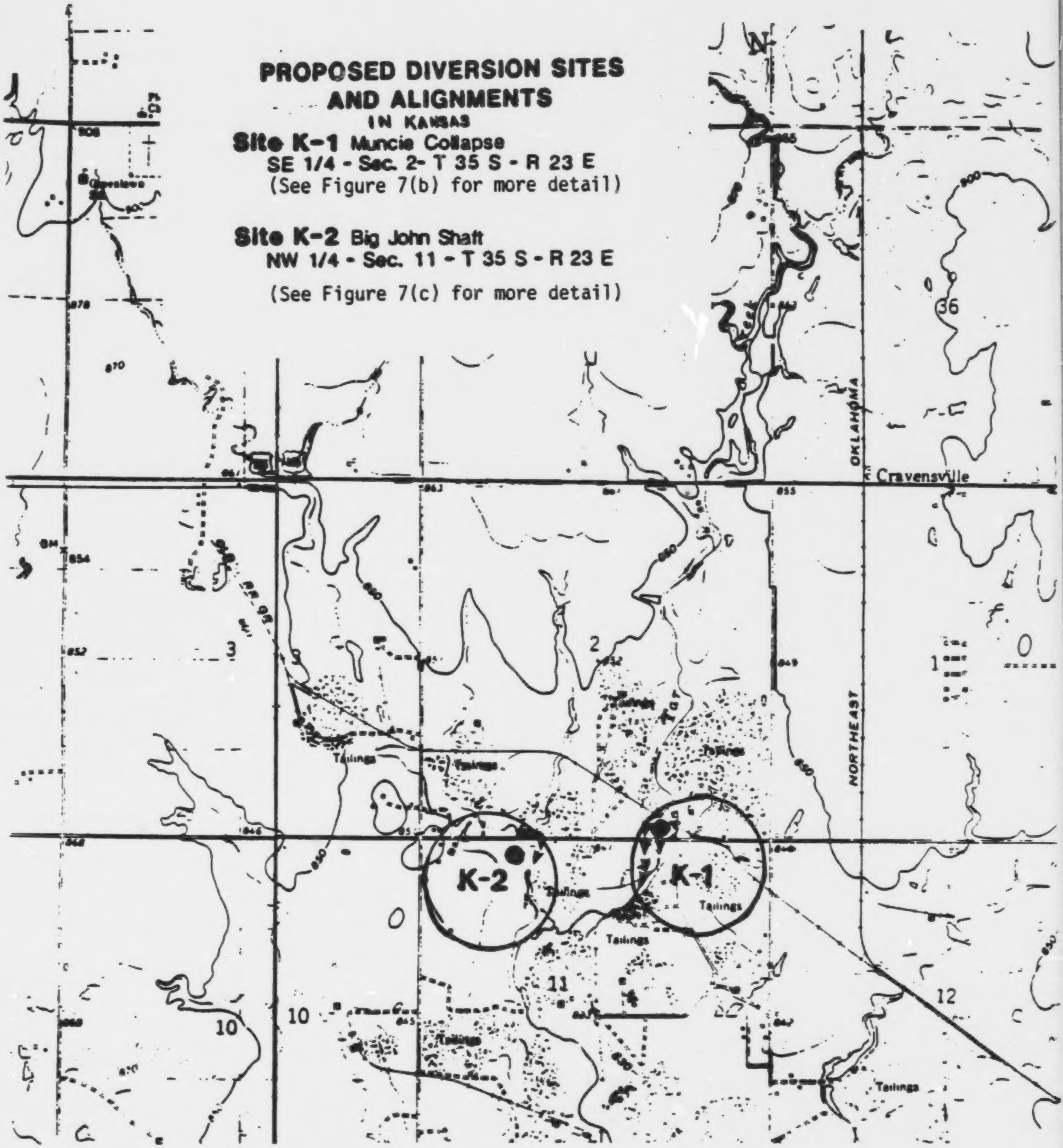
Since the Tar Creek basin is susceptable to long-term subsidence, future subsidence may require further diversion and diking if streams are pirated. If and when these new areas form, or existing areas increase in size, additional information would need to be collected determining impact and potential for outflow.

The diversion program will constitute rerouting surface flows away from mine shafts, subsidence areas, and open boreholes. Three major inflow areas allowing approximately 75% of the yearly surface flows into the mine workings are designated for diversion work. The highest priority site is a subsidence area in Kansas called Muncie. This subsidence is located in the stream channel of Tar Creek and funnels surface flow from 4.52 sq mi of drainage area into the mine system. This area is characterized as having a pond and several beaver dams that impound water in a low area. These activities which occurred after mining operation have caused the creation of a small wetlands region. It appears that rerouting the stream flow with the use of excavated channel and a supporting dike is the most feasible method of diversion at this time (Figures 7 & 8). It is further proposed to reroute the Tar Creek stream flow to the west of the present channel.

Several other areas identified as inflow areas were studied and evaluated for diversion work. These areas did not contribute significant amounts of water individually although collectively they account for 25 percent of the inflow. Areas identified as 0-5 though 0-18, and K-8 were excluded because the work would involve minimal reduction in outflow for an administratively intensive effort, lengthy time to construct, and relative high cost.

4. Alternative Drinking Water Supplies

Other potential sources of drinking water could be made available to the area if they were necessary. These sources include Grand Lake and the Neosho River which provide water for areas outside the study area already. In the unlikely event that large scale contamination of the Roubidoux occurs, the feasibility study considered constructing a water line to the Commerce City



PROPOSED DIVERSION SITES
AND ALIGNMENTS
IN KANSAS

Site K-1 Muncie Collapse
SE 1/4 - Sec. 2- T 35 S - R 23 E
(See Figure 7(b) for more detail)

Site K-2 Big John Shaft
NW 1/4 - Sec. 11 - T 35 S - R 23 E
(See Figure 7(c) for more detail)

N
K-1
K-2
Tailings
Cravensville
OKLAHOMA
NORTHEAST
36
3
2
1
10
11
12
850
870
878
900

Figure 7(a).

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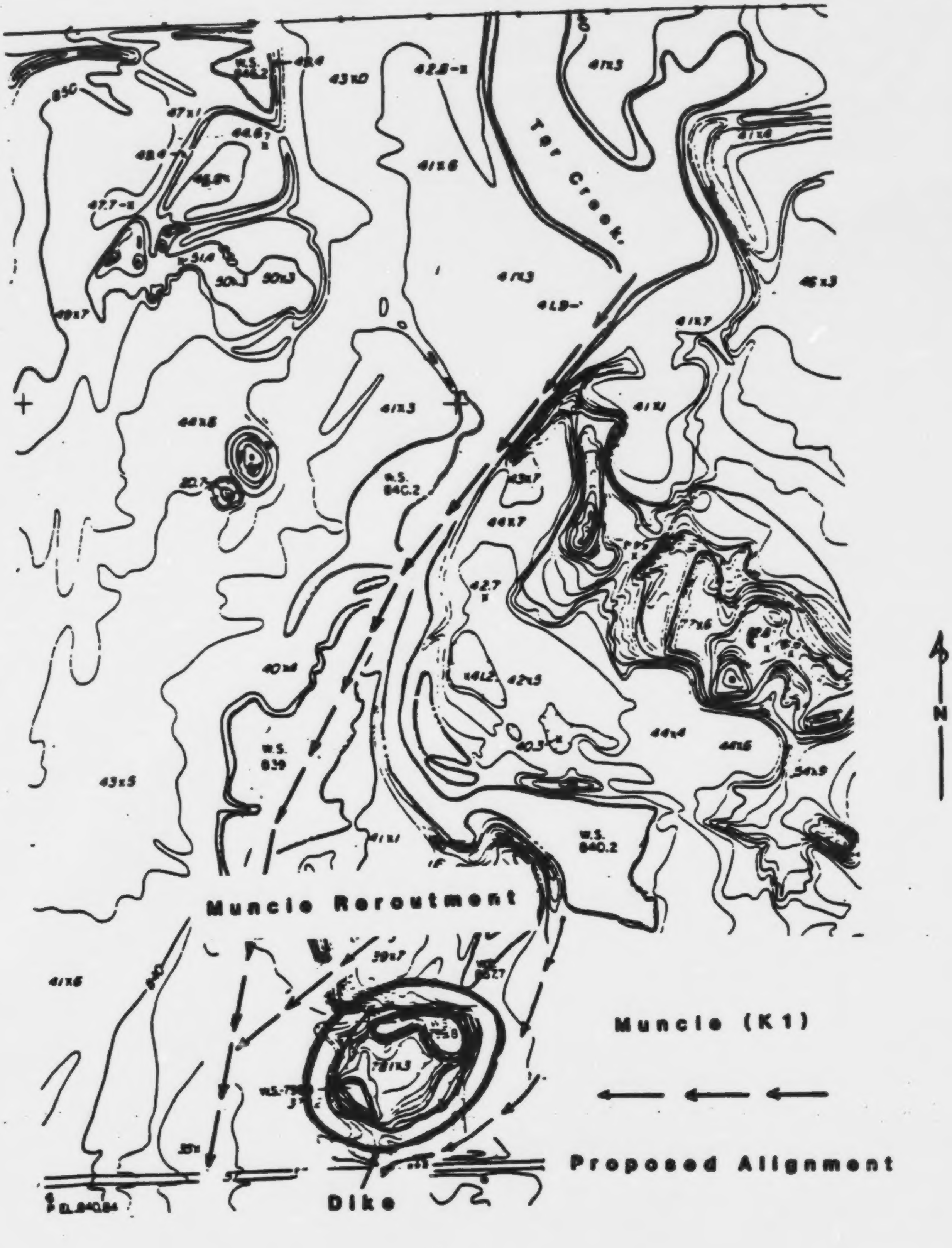
850
W.S. 842.2
43x0
42.8-x
41x3
47x1
41x6
Tar Creek.
41x6
47.7-x
51.6
50x3
50x3
49x7
41x3
41.9
45x3
41x7
44x8
41x3
41x1
W.S. 840.2
44x7
42.7
40x6
42x3
W.S. 839
43x5
44x6
44x6
W.S. 840.2
41x6
Muncie Reroutment
39x7
78x3
Muncie (K1)
Proposed Alignment
Dike
N

Figure 7(b).

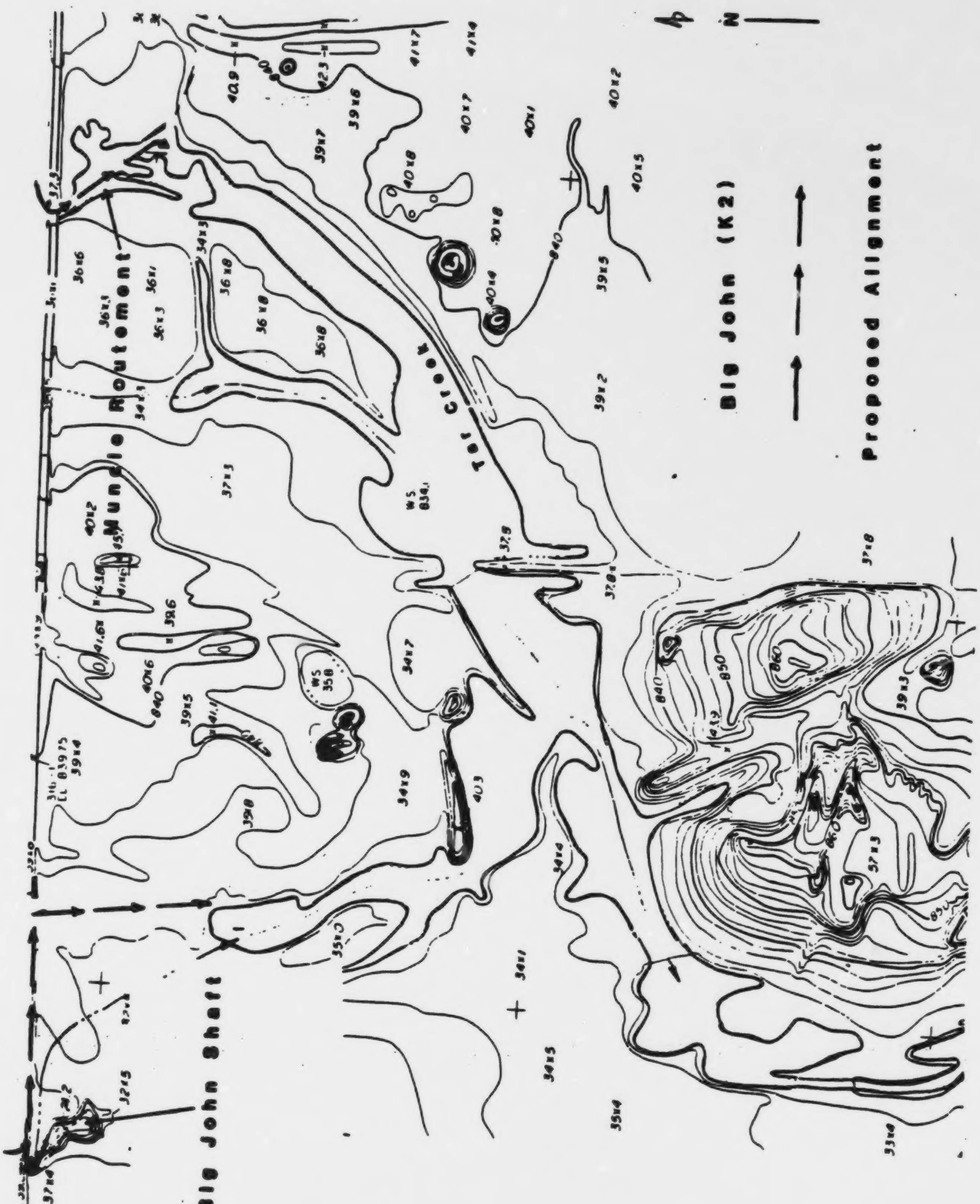
Big John Shaft
Mundele Routement
Tel Creek
Big John (K2)
Proposed Alignment
N
840
850
860

Figure 7(c).

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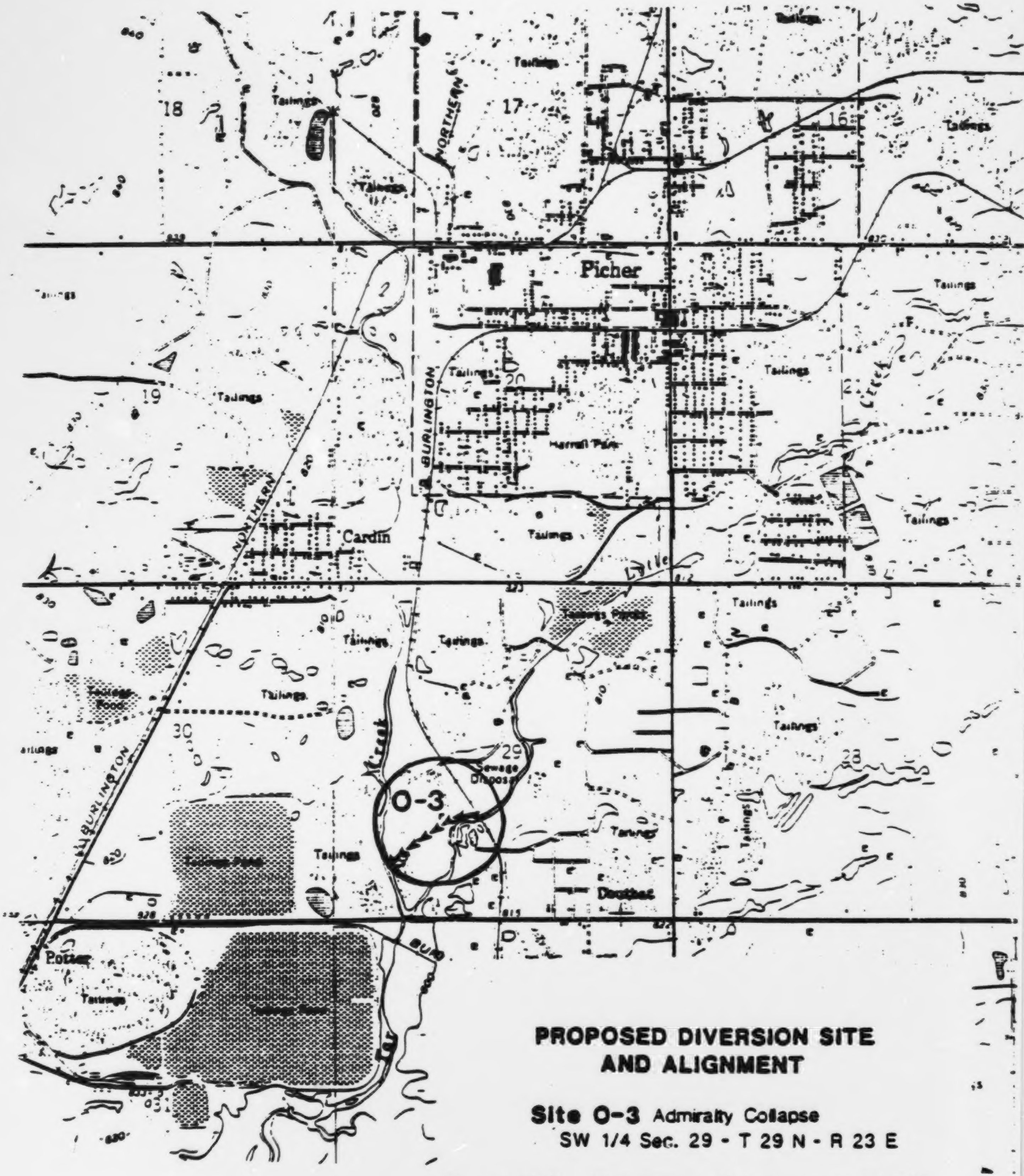
Tailings
Picher
Cardin
Potter
Douthat
NORTHERN
BURLINGTON
Sewage Disposal
Tailings Pond
O-3
18
17
16
19
20
30
29
28
31
Creek
Harrell Park

PROPOSED DIVERSION SITE AND ALIGNMENT

Site O-3 Admiralty Collapse
SW 1/4 Sec. 29 - T 29 N - R 23 E

Figure 7(d). (See Figure 7(e) for more detail)

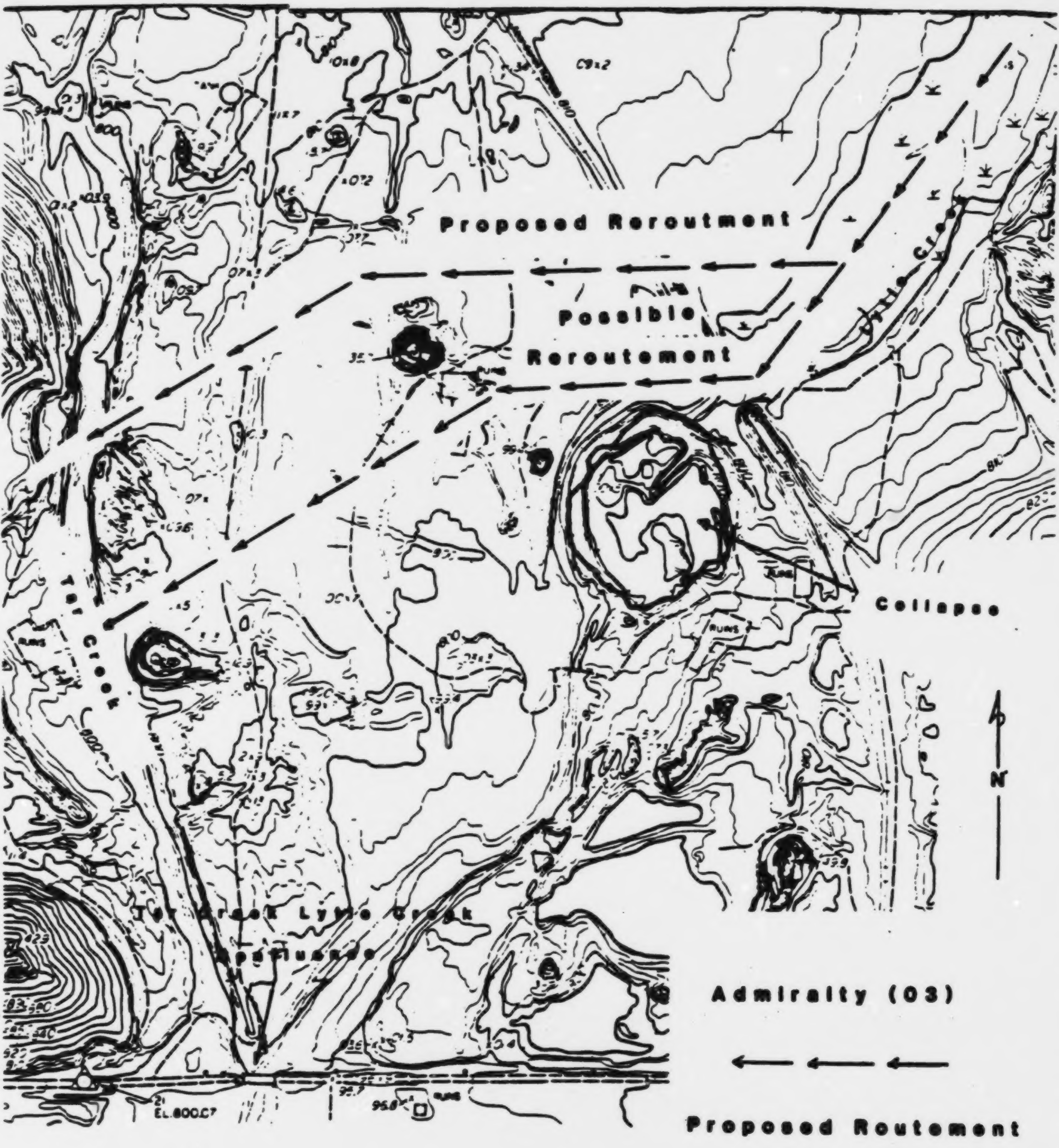
Proposed Reroutment
Possible
Reroutement
Lytle Creek
Collapse
Tar Creek
N
Tar Creek Lytle Creek
Confluence
Admiralty (03)
Proposed Routement

Figure 7(e)

Cross-section of Channel and Supporting Dike

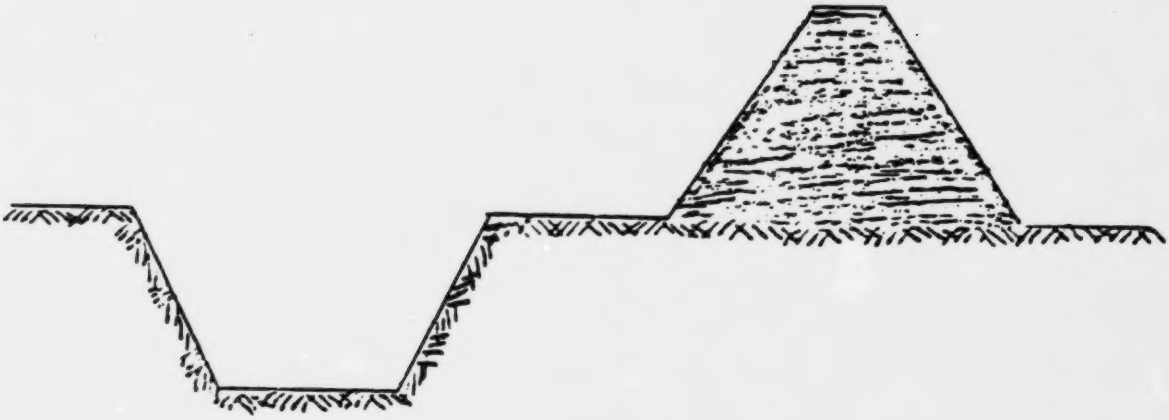

Figure 8.

from Grand Lake. The ground water monitoring plan is expected to detect contamination before it becomes a significant problem. Since the Roubidoux is not contaminated except for a few localized spots, alternative drinking water supplies are not necessary at this time. The cost for building and maintaining this system was the most costly at $17 million.

5. Surface Discharge Treatment

Surface discharge of contaminated water is the major cause of Tar Creek's poor quality. Treatment of the water outflow would conceivably reduce or eliminate most of the problem. The treatment facilities would be located adjacent to areas of major outflow. This alternative would only capture a portion of the outflow since small springs and smaller outflow areas would not be treated. No water is expected to outflow from the major outflows areas after completion of the diversion work thereby rendering this option unnecessary. The projected cost for this alternative was approximately twice the cost of the recommended alternatives.

Cost-Effectiveness Analysis of Alternative

A cost-effectiveness evaluation was performed on the surface and ground water alternatives. Using this methodology, candidate alternatives were evaluated against each other according to several measures of effectiveness and cost. The measures of effectiveness that were used are as follows:

- Technology status
- Risk and effect of failure
- Level of cleanup/isolation achievable
- Ability to minimize community impacts during implementation
- Ability to meet relevant public health and environmental criteria
- Time required to achieve cleanup/isolation

1. No-Action

No-action at Tar Creek was rejected by the State and Region because of the continuing twin threats of ground water contamination of the Robidoux and surface water discharge of contaminated mine water. The Roubidoux is the principle source of water for the area. Contamination of the aquifer would lead to loss of community and private wells in this area of Kansas and Oklahoma.

Natural restoration of the Boone aquifer is estimated to take at least 100 to 150 years. This timeframe is unacceptable considering the threats posed at the site.

2. Evaluation of Alternatives to Protect Drinking Water

The principle alternative examined to protect the Roubidoux aquifer was the plugging of 66 wells. Plugging the wells will effectively abate future migration of contaminated Boone aquifer water into the Roubidoux. The well plugging alternative uses established and proven technology associated with well drilling, easement and abandonment. The risk of unsuccessful well plugging is low; however, there is a remote possibility that fissures in the Jefferson formation may also provide routes for contaminated mine water. Well plugging requires very little design work and, therefore, construction can begin within three or four months after the project is funded. Construction is expected to be completed within six to twelve months.

Provision of alternative water supply from Grand Lake to Commerce was another option examined. The purpose of this option was to provide a more reliable source of drinking water to the Town of Commerce. This option has a capital cost of more than $17,000,000. The new system can be built using existing technology, it would achieve drinking water criteria and would have minimal community impact. Compared to well abandonment, this option is very expensive and not necessary. Other towns and rural areas would not be provided water from this system if wide spread contamination occurs. Additional supply alternatives would need to be considered.

3. Evaluation of Alternatives to Protect Surface Water

Diversion and diking of inflow points and treatment of surface water discharge were evaluated as remedial actions to mitigate the contamination of Tar Creek and several of its tributaries. The diversion and diking alternative would direct approximately 3,200 acre-feet per year. Surface discharge is approximately 1,000 acre-feet per year and, therefore, little or no surface discharge is expected after implementation of this remedy.

The construction of berms and dikes and the rechannelization of creeks relies on well established earth work technology. (No hazardous wastes are managed.) The remedy will require nominal long-term maintenance and should not be damaged as a result of flooding.

No adverse community impacts are projected; in fact, the diversion structures considered near the Town of Commerce will not be constructed because the flood stage would be increased.

Construction is expected to be limited from six to nine months. Surface water outflow should be fully reduced or eliminated within twelve to eighteen months after construction is completed.

Treatment of surface discharge was also evaluated. The type of treatment system has not been fully developed and treatability studies would be required before design parameters could be established. The capital and O&M costs estimates reported in Figure 4 are subject to wide variation. This treatment remedy would not be fully effective since there are smaller outflow points that would not be treated. Approximately twelve months would be required to implement the remedy and it would require at least 30 years of operation and maintenance.

COMMUNITY RELATIONS

The public comment period, from January 26 through February 16, 1984, was announced in a January 10, 1984, news media release. The Investigation, Feasibility and draft Record of Decision were placed in eight repositories for public review. A February 9, 1984, public meeting was held at the Ottawa County Courthouse in Miami, Oklahoma, to answer questions pertaining to the Remedial Investigation/Feasibility Study activities and the recommended alternatives. At the public meeting there were several Federal and State agencies, political officials, news media, school children, private industries and local citizens. Most questions that were raised were of a general nature requesting more information about the recommended alternatives. Some technical comments were made regarding adequacy of the remedial technologies to be used. None of the technical comments were of such importance to alter the proposed remedies or their design. The school children in attendance submitted a petition with signatures requesting that EPA pursue remedial actions for Tar Creek. Overall very few commenters disagreed with the recommended alternatives. Responses to verbal and written questions or comments are in Addendum 2, the responsiveness summary. In addition to comments received during the public comment period, Eagle-Picher provided substantial comments on February 21, 1984, and raised other legal issues in a letter to Allyn Davis, EPA Region VI, dated February 15, 1984. Addendum 2 includes responses to these comments.

CONSISTENCY WITH OTHER ENVIRONMENTAL LAWS

The diversion and diking program will affect two areas of concern related to surface water use: flooding and wetlands. Executive Orders 11988 and 11990 require Federal agencies to determine potential effects of planned actions in a floodplain and wetlands, and to minimize such impacts. No alternatives to construction were available except for no-action. In accordance with these regulations an impact assessment for the Tar Creek diversion and diking program is given in Addendum 3.

RECOMMENDED ALTERNATIVES

Section 300.68(j) of the National Contingency Plan states that "The appropriate extent of remedy shall be determined by the lead agency's selection of the remedial alternative which the agency determines is cost-effective (i.e. the lowest cost alternative that is technologically feasible and reliable and which effectively mitigates and minimizes damage to and provides adequate protection of public health, welfare or the environment)." Based upon investigation and feasibility studies, EPA Region VI and the States of Oklahoma and Kansas agree that the well plugging, and the diversion and diking programs meet the NCP criteria.

The diversion program will constitute rerouting surface flows away from mine shafts, subsidence areas, and open boreholes. Three major inflow areas allowing approximately 75% of the yearly surface flows into the mine workings are designated for diversion work. The Muncie and Big John diversion work will be implemented at the completion of design. However, the Admiralty diversion work will be delayed twelve to eighteen months to establish new inflow and outflow patterns. The Admiralty will be constructed, if required.

Because the diversion work may not completely stop all surface discharge of acid mine water, a ground water monitoring program of the Boone aquifer will be conducted for two years to allow time for the system to equilibrate and to determine the effectiveness of the diversion work. If there continues to be significant discharge, remedial measures would be evaluated to determine if further action is appropriate.

There are many more inflow areas that were considered, but each taken on a individual basis is insignificant compared to the top three priority sites. Therefore, to do diversion work at these sites would result in decreasing environmental protection that cannot be justified by the increased costs. The capital cost for diversion at the three sites is $2,000,000 with O&M costs of $5,000 per year for 30 years.

The diversion work may not completely stop the surface discharge of mine water. A surveillance program will be initiated after construction to record ground water level changes. The plan for this monitoring program along with the water quality monitoring program for the Roubidoux is given in Addendum 4.

Well plugging is the cost-effective remedy to protect the Roubidoux. This portion of the remedy is expected to cost $2,000,000 and should assure that contaminated mine waters from the Boone do not affect the Roubidoux. Provision of an alternative source of water to the Town of Commerce is not required because the Roubidoux is a safe source of drinking water. The State will undertake a long-term ground water monitoring program of the Roubidoux to assure the safety of the Roubidoux.

ADDENDUM 1

ADDENDUM 1

Alternatives	Cost Measures				Effectiveness Measures								Effectiveness Measures Specific to the Site					
	Construction	Operation & Maintenance	Other Present worth X 1 million	Σ Cost Ratings	Technology Status	Risk and Effect of Failure	Level of Cleanup/Isolation Achievable	Ability to Minimize Community Impacts During Implementation	Ability to Meet Relevant Public Health and Environmental Criteria	Time Required to Achieve Cleanup/Isolation							Σ Effectiveness Ratings	Σ Effectiveness Ratings / ΣCost Ratings
Weighting Factors					0.6	1.1	1.0	0.7	0.6	0.5								
Ground water Alternatives																		
1. Alternative drinking water supplies Roubidoux Grand Lake			37.6 38.3		3 3	4 4	1 1	2 2	4 4	3 3						125 125	.332 .326	
2. Well Plugging			1.78		4	3	3	4	3	5						158	8.88	
Surface Water Alternatives																		
1. Surface Discharge Treatment			4.09		3	4	4	3	4	3						16	3.96	
2. Diversion			1.86		4	2	3	3	3	3						13	5.97	

ADDENDUM 2

Second, and even more important, EPA has refused to recognize the pervasive role of the United States government in the development and operation of the Ottawa County mining industry. Eagle-Picher has provided EPA with records and documents illustrating the government's extensive participation. This information demonstrates that the United States, acting through the Bureau of Indian Affairs (BIA) and the United States Geological Survey (USGS) was actively involved in all aspects of the development of mining, both as an "owner" of the minerals and an "operator" of those minerals. In its role as "mineral owner," the government acted as lessor of the mineral rights on behalf of individual members of the Quapaw tribe of Indians who had been made wards of the United States by act of Congress. Leases involving Indian minerals were drafted by and negotiated with the BIA. Royalties were paid not to the Indians but to the BIA. That agency then parcelled out those royalties to the Indians involved, in some cases retaining a portion (apparently ten percent) on account of the BIA's "supervision of mining operations."

As an "operator" of the minerals, both the BIA and the USGS were also involved in the day-to-day mining operations. These agencies determined where mine shafts and mineral processing facilities were to be located. The agencies determined whether, upon lease surrender, mine shafts were to be sealed or left open. Indeed, the timing of the ultimate decision to cease mining and the maintenance operations necessary to mining, including mine pumping, was determined by these federal agencies. It is important to note that the federal government did not participate in the mining operations simply as a "regulator." On the contrary, the government made day-to-day operating decisions as a participant in the operations, motivated by the desire to procure the greatest possible mineral recovery.

Under these circumstances the federal agencies involved must be regarded as much a "responsible party" as the landowners and operating companies. The recognition of the federal government as a "potential responsible party" in this matter is also completely in accord with EPA's own policy on the identification of "potential responsible parties." Nonetheless, EPA has steadfastly refused to either consider the issue of the government's responsibility or discuss its rationale for this position.

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At the January 16, 1984 meeting Eagle-Picher again raised this issue. We were told only that the Region VI legal staff "does not agree" that the government should be regarded as a "potential responsible party." When asked to discuss their rationale they declined to do so saying that they were not prepared to reveal their "theory of the case" to Eagle-Picher and other participants at the meeting. Finally, Region VI representatives stated that they had not even discussed this issue with the agencies involved and had no present intention of doing so.

EPA's response, to date, to this issue is not in accord with the agency's own policy. Furthermore, EPA's attitude misses the essential point. The question is not simply a legal issue involving litigation strategies such as secret "theories of the case" and calculated refusals to deal with obvious facts. The issue is not one of parsing statutory language for liability but who should participate in resolving this matter without litigation by implementing the measures determined to be advisable.

The results of the recent Tar Creek verification and feasibility studies reinforce the need to seek a viable solution to the situation unencumbered by simplistic, legalistic theories. A review of the results of the verification and feasibility studies indicates that they have concluded that the environmental situation does not present an imminent and substantial danger to the public health or welfare. Consequently, it would not be possible to fund remedial actions at the site under CERCLA, even if, as the government has argued, a site such as Tar Creek can be addressed under the provisions of the statute concerning releases or threatened releases of "pollutants or contaminants."

As CERCLA can no longer be regarded as a proper funding mechanism under any "theory of the case," it is now more important than ever that the government abandon its litigious approach to the situation and join in the efforts of others such as Eagle-Picher to find a practical solution to the problem of implementing any advisable further actions at the site.

6

Eagle-Picher restates its willingness to discuss the identification and implementation of advisable measures. Unfortunately, unless the government is equally prepared to discuss this issue, not as a litigant but as a potential participant, we doubt that meaningful discussions capable of resolving this important matter are possible.

As we informed you at the January 16, 1984 meeting, Eagle-Picher believes that the issue of government participation has not received adequate attention at responsible management levels within EPA and the other federal agencies concerned. As the Region VI representatives attending the meeting declined to address this issue with agency management, Eagle-Picher will, as we informed you, make an effort to do so. We hope that this issue will receive the attention it deserves and that it can be addressed in a manner conducive to making progress on the overall resolution of this matter.

In regard to the last paragraph of your letter of December 20, 1983 please be advised that Eagle-Picher is continuing to review its available records for information relevant to your request of June 29, 1983. Because of the voluminous and fragmentary nature of these records the time and expense involved in this search continues to be substantial. In accordance with the policy of Eagle-Picher discussed in my letter of August 3, 1983 to Mr. David Price, we will provide you with any meaningful information relevant to your June 29, 1983 request as soon as it becomes available. Also please note that Mr. Price was informed of the status of Eagle-Picher's record search in our telephone conversation of September 27, 1983.

Once again, let me assure you that Eagle-Picher stands ready to discuss the resolution of this matter with the federal government and others who participated in the development of mining in Ottawa County.

Sincerely yours,

Richard A. Flye
Counsel to Eagle-Picher
Industries, Inc.

cc: Ron Jarman
John Wade

7

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION VI
1201 ELM STREET
DALLAS, TEXAS 75270

APR 5 1984

Richard A. Flye, Esquire
McKenna, Conner and Cuneo
1575 Eye Street, N.W.
Washington, D.C. 20460

Dear Mr. Flye:

This is in response to your letters of February 6 and 15, 1984 and to the comments made by you at the Tar Creek Superfund Meeting in Dallas on January 16, 1984. I have enclosed a copy of a summary of that meeting for your information.

EPA is aware of Eagle-Picher's views regarding the possible inclusion of agencies of the U.S. Department of the Interior as responsible parties at the Tar Creek, Oklahoma, Superfund Site. Your contentions have been made known to both Headquarters and Regional Superfund staff. The EPA, however, is not prepared to accept your argument that the U.S. Government must be considered a responsible party under Superfund prior to the initiation of serious settlement discussions or Superfund remedial action at Tar Creek. Further, EPA does not believe that it is required to go beyond its already extensive investigation into responsible parties, or to modify its determination of responsible owners/operators. Eagle Picher is, or should be, aware that this agency takes the position that responsible parties may be jointly and severally liable under Sections 104, 106, and 107 of CERCLA, 42 U.S.C. §9604, 9606, 9607. Further, EPA believes that it may exercise enforcement discretion in naming and noticing responsible parties under CERCLA and in later suing such parties for appropriate relief, if necessary.

It has been made clear through communications from this agency that EPA considers Eagle-Picher a responsible party at the Tar Creek Superfund Site. It is also clear that Eagle-Picher has been given an opportunity to accomplish remedial action at the site, yet has not to this date chosen to do so, either individually or collectively with other responsible parties. Eagle-Picher has instead chosen to make an issue of its argument for government liability for the Tar Creek environmental problems prior to any commitment toward remedial action of the Tar Creek problem. Yet, Eagle-Picher was informed by EPA at the January 16, 1984, meeting that Eagle-Picher should proceed with its plans on the assumption that the government would not be named as a responsible party.

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EPA is committed to resolution of environmental problems at Tar Creek, consistent with the National Contingency Plan (NCP). Accordingly, once the Assistant Administrator for Solid Waste and Emergency Response has made a final decision upon the record, an event that should occur shortly, there will be a 30 day period in which any potentially responsible party can formally settle with EPA for private party implementation of the remedy, should one be chosen. If such settlement cannot be reached within that 30 day period, EPA may proceed to implement the chosen remedy, using the Superfund and seeking Cost Recovery under Section 107 of CERCLA from responsible parties, for all costs of remedial action incurred and not inconsistent with the NCP.

In answer to your question concerning mutual review of the BIA records in Albuquerque, we do not intend to review those records at this time. Please call Jim Turner at (214) 767-9975 or David Price at (214 767-9701 if you have any questions.

Sincerely yours,

Samuel J. Nott

Samuel J. Nott, Chief
Superfund Branch

cc: Charles Dautel
Vice President, Eagle-Picher Industries, Inc.

2

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WRITER'S DIRECT DIAL NUMBER
(202) 789-7682

RICHARD A. FLYE

February 16, 1984

RECEIVED
FEB 21 1984
Oklahoma Water Resources Board

Ron Jarman, Chief
Water Quality Division
Oklahoma Water Resources Board
P.O. Box 53585
1000 N.E. 10th Street
Oklahoma City, OK 73152

Re: Tar Creek Feasibility Study

Dear Mr. Jarman:

Enclosed please find the comments of Eagle-Picher Industries, Inc. (Eagle-Picher) concerning the Tar Creek feasibility study and the "proposed remedies" announced by Governor Nigh on January 9, 1984.

These comments are being provided in response to the request for comments made in EPA's January 10, 1984 press release.

May I also say that Eagle-Picher appreciates the professional way in which the Task Force has approached its work. We hope that Eagle-Picher has been able to be of some assistance to you and the other Task Force members. We look forward to continuing to work with you as the activities at Tar Creek proceed.

Should you have any questions concerning the enclosed comments or should you desire further information, please feel free to contact me at (202) 789-7682.

Sincerely yours,

R A. Fly

Richard A. Flye
Counsel to Eagle-Picher
Industries, Inc.

RAF/pw
Enclosure

cc: Allyn M. Davis (w/enc.)

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RICHARD A. FLYE

March 22, 1984

James L. Turner, Esquire
Attorney, Office of Regional
Counsel (6ORC)
United States Environmental
Protection Agency
Region VI
1201 Elm Street
Dallas, TX 75270

Re: Tar Creek, Ottawa County, Oklahoma
CERCLA Site

Dear Mr. Turner:

This is to confirm our recent discussions concerning EPA's treatment of the comments submitted by Eagle-Picher Industries, Inc. (Eagle-Picher) on the remedial alternatives proposed by the Tar Creek Task Force and EPA for the Tar Creek site. These comments were submitted by Eagle-Picher by first class mail, prepaid, on February 16, 1984.

As we discussed, it came to my attention on March 19, 1984, from a non-EPA source, that EPA was taking the position that Eagle-Picher's comments would not be considered in the final remedial alternatives decision for Tar Creek because they had been received "late," i.e., after the February 16, 1984 date for submission of comments mentioned in EPA's January 10, 1984 press release soliciting comments.

I was glad to learn from you on March 21, 1984 that, following our discussions, the agency has decided that Eagle-Picher's comments will be included among the decision documents forwarded to EPA headquarters and will be considered by the agency in reaching a remedial determination in the Tar Creek matter.

I understand that Region VI will soon be forwarding an addendum to the decision documents to headquarters. This addendum will include Eagle-Picher's February 16, 1984 comments as well as the Region's views on those comments. I would appreciate receiving a copy of the Region's views.

I further understand that the Region's transmittal of the addendum will represent that Eagle-Picher's comments were not included in the original package because they were received "late." As we discussed, Eagle-Picher does not believe that its comments were "late," as a matter of either law or sound policy. In the absence of any statute or regulation to the contrary, we believe comments on proposed remedial alternatives should be considered filed when mailed. Certainly, as a matter of good environmental and agency policy, EPA should always be prepared to receive and consider comments, such as those submitted by Eagle-Picher, containing significant technical and scientific information, particularly when they are received, as you noted, well before the decision document package is prepared and forwarded to headquarters.

In any event, the important point is that EPA has now decided to make Eagle-Picher's comments a part of the decision document package and accord them the full consideration they deserve. How the agency chooses to characterize the timing of their receipt is not of major significance.

I appreciate the willingness of the agency to reconsider its initial judgment on this matter. May I assure you again that Eagle-Picher wishes to work with the agency in achieving an appropriate resolution to the Tar Creek matter. May I also suggest that a positive, cooperative approach to this matter can be further fostered if, should this type of procedural issue arise in the future, EPA promptly communicates its position to the other parties concerned so that the issue can be resolved without the need for extensive and time-consuming discussion and reconsideration.

Again, thank you for your attention to this matter.

Sincerely yours,

Richard A. Flye
Counsel to Eagle-Picher
Industries, Inc.

RAF/pw

cc: [redacted]
Lee M. Thomas

ADDENDUM 3

ADDENDUM 3

Tar Creek Site
Ottawa County, Oklahoma

Remedial Alteratives Analysis

FLOODPLAIN AND WETLANDS MANAGEMENT ASSESSMENT

I. PURPOSE

The purpose of this addendum is to:

1. Review Executive Order No. 11988, May 24, 1977, 42 F.R. 26951 entitled Floodplain Management.
2. Review applicable statutes referred to in the Executive Order as required.
3. Review the Tar Creek Site Remedial Alternatives Analysis in areas discussing floodplain management.
4. Summarize the review and describe additional technical requirements to comply with applicable requirements.

II. INTRODUCTION

The potential for diverting surface runoff from entering the mine system by using dikes and diversions was identified early in the planning process. Feasibility Studies revealed surface inflow as the largest contributor to the water in the mined areas. Two locations (the Muncie and the Big John) contribute 72 percent of the total surface inflow into the mining system. A third area of major interest is the Admiralty area which is currently an outflow point but in all probability would become an inflow point if the water level in the mines is lowered by diversion or other means. The fourth area of major interest with regard to diversion is the numerous subsidence features located on the west side of Commerce, Oklahoma. This section will address the change in flooding potential resulting from the diking and diversion of surface runoff at the four major points of inflow.

III. PROCEDURE

In order to develop a water surface profile on Tar Creek, valley cross sections were taken from the Flood Plain Information Study on Miami, Oklahoma,* from 7.5 minute USGS quadrangle maps, and from limited field surveys in key locations. All bridge dimensions used in the study were taken by field measurements. The water surface profile computations were made using the Soil Conservation Service (SCS) program for water surface profiles (Technical Release No. 61).

The entire Tar Creek basin including the underground mine system was modeled using the SCS Watershed Computer Model - TR 20. The basin as it currently exists was modeled initially. The elevation-storage relationship for the underground mine area was developed from information from the Oklahoma Geological Survey. The elevation-discharge relationship was developed from discharge information collected by the U.S. Geological Survey and the Oklahoma Water Resources Board. The routings of current conditions produced peak discharges at locations in Miami, Oklahoma, that compared favorably with published data in both the Flood Plain Information and Flood Insurance Study.

The combined effects of the four diversion locations identified in the introduction of this section were then evaluated using the same SCS TR20 computer program. The changes in flooding potential resulting from diversion and diking activities were noted at key locations throughout the Tar Creek basin.

IV. FLOOD HAZARD ASSESSMENT

The changes in discharge and elevation resulting from proposed diking and diversion activities at key locations throughout the Tar Creek basin are displayed in Table 5. Increased flood stages below K-1, K-2 and O-3 are not significant.

The maximum increase in stage was 1.32 feet for the 50 year flood at the Tar Creek bridge west of the Picher High School. Increases in maximum stage ranged from 0.19 to 1.32 feet in the area above the confluence of Tar and Lytle Creeks. This increase in stage would be limited to agricultural areas and would not involve any homes or urban areas.

The maximum increase in stage noted on the mainstream of Tar Creek between its confluence with Lytle Creek and Neosho River was 0.22 feet. This increase in stage is insignificant.

If the area west of Commerce is diverted south into the tributary just east of the Miami Airport, the increases in stage could be from 0.33 to 0.52 feet. Since this area already has a significant flooding problem as identified in the June 1980, Flood Increase Study, diversion into the tributary is not recommended. The maximum amount of water that could conceivably be diverted from the subsidence area west of Commerce is approximately 325 acre feet per year (11.5 inches from 339 acres). Since the amount of water to be diverted is so small in relation to the total surface inflow and the resulting increase in flooding due to diversion to the south complicates an already important flooding problem, diversion of this area is not recommended.

Table 5 shows data developed from the computer model. All sites monitored and modelled are located in rural agricultural lands or parkland except for sites F and G. These two sites are located near Commerce City and were determined to significantly impact the floodplain. Current stream levels cause flooding in developed areas near sites F and G. Any additional flow would only increase the flooding damage. Even though this increase is not as great as some of the other sites, the impact is in a developed area rather than agricultural or parkland area.

V. WETLANDS HAZARD ASSESSMENT

As discussed in the "Proposed Actions" section, the diversion work planned at the Muncie Site will involve a wetlands area approximately 80 to 100 acres in size. The total wetlands lost is estimated to be 0.37 acres. Construction of the dike will encroach the south east corner of the pond. This will involve filling in less than one acre. In addition, a channel will be deepened to accommodate the extra water flow with a minimal amount of impact to the rest of the pond. As discussed in the Alternatives Evaluation there are no other effective remedies that adequately address the in flow problem at this site. The State of Kansas Fish and Wildlife Department had no comments concerning this aspect of the project. The U.S. Army Corps of Engineers is evaluating the project for technical consistency with its §404 program. A final opinion will be made during the actual design phase.

Dewatering the area where construction is planned will eliminate a small amount of the wetlands, however, most can be saved by rechannelling one mile of Tar Creek to the west of the present channel and allowing some runoff to enter the wetlands area.

TABLE 5(a)

TAR CREEK

NET EFFECTS OF PROPOSED DIVERSIONS

Location	Return Frequency Years	WO/Diversion Peak Discharge CFS	WO/Diversion Elevation MSL	W/Diking & Diversion Peak Discharge CFS	W/Diking & Diversion Elevation MSL	Net Increase Due to Proposed Diversions Discharge CFS	Net Increase Due to Proposed Diversions Elevation Feet
A. **Oklahoma-Kansas State Line West of Treece** 2 miles below K-1 and K-2, in an agricultural area.	100	2482	821.81	4711	822.52	2229	0.71
	50	2124	821.65	4007	822.35	1883	0.70
	25	1813	821.51	3395	822.16	1582	0.65
	10	1438	821.34	2664	821.90	1226	0.56
	5	1122	821.08	2066	821.62	944	0.54
	2	800	820.84	1437	821.33	637	0.49
	1	671	820.75	952	820.94	281	0.19
B. **Tar Creek at Bridge West of Picher High School** Near O-12, in an agricultural area	100	2267	813.22	4751	814.51	2484	1.29
	50	1917	812.96	4033	814.28	2116	1.32
	25	1622	812.70	3411	813.95	1789	1.25
	10	1279	812.23	2670	813.50	1391	1.27
	5	1010	811.81	2066	813.08	1056	1.27
	2	806	811.24	1433	812.47	627	1.23
	1	643	810.79	957	811.66	314	0.87

TABLE 5b

TAR CREEK

NET EFFECTS OF PROPOSED DIVERSIONS

Location	Return Frequency Years	WO/Diversion Peak Discharge CFS	WO/Diversion Elevation MSL	W/Diking & Diversion Peak Discharge CFS	W/Diking & Diversion Elevation MSL	Net Increase Due to Proposed Diversions Discharge CFS	Net Increase Due to Proposed Diversions Elevation Feet
C. **Confluence of Tar and Lytle Creeks**	100	8437	803.54	9385	803.81	948	0.27
Near O-3 in an agricultural area.	50	7213	803.19	7947	803.40	734	0.21
	25	6181	802.76	6733	803.03	552	0.27
	10	4962	802.14	5281	802.32	319	0.18
	5	3939	801.51	4113	801.62	174	0.11
	2	2803	800.78	2876	800.83	73	0.05
	1	1911	799.92	1944	799.96	33	0.04
D. **Highway 66 Bridge N.W. of Commerce**	100	11216	794.61	11993	794.87	777	0.26
In an agricultural area.	50	9590	794.06	10188	794.26	598	0.20
	25	8237	793.61	8687	793.76	450	0.15
	10	6652	792.95	6908	793.06	256	0.11
	5	5317	792.22	5465	792.31	148	0.09
	2	3814	791.22	3879	791.27	65	0.05
	1	2615	790.23	2646	790.26	31	0.03

TABLE 5(c)

TAR CREEK

NET EFFECTS OF PROPOSED DIVERSIONS

Location	Return Frequency Years	WO/Diversion Peak Discharge CFS	WO/Diversion Elevation MSL	W/Diking & Diversion Peak Discharge CFS	W/Diking & Diversion Elevation MSL	Net Increase Due to Proposed Diversions Discharge CFS	Net Increase Due to Proposed Diversions Elevation Feet
E. onfluence of Tar Creek and Trib Below Site 14	100	12790	781.38	13506	781.51	716.	0.13
In an agricultural area.	50	10955	781.05	11499	781.15	544.	0.10
	25	9430	780.78	9833	780.85	403.	0.07
	10	7657	780.29	7882	780.35	225.	0.06
	5	6172	779.61	6303	779.68	131.	0.07
	2	4470	778.57	4531	778.62	61.	0.05
	1	3095	777.52	3123	777.55	28.	0.03
F. Confluence of Tar Creek and [illegible] East of Airport (just) above Burlington Railroad)	100	13131	775.01	13921	775.23	790.	0.22
In an area susceptable to flooding damage before diversion work.	50	11264	774.49	11864	774.66	600.	0.17
	25	9727	774.06	10167	774.19	440.	0.13
	10	7932	773.34	8203	773.45	271.	0.11
	5	6414	772.72	6591	772.80	177.	0.08
	2	4658	771.96	4757	772.02	99.	0.06
	1	3231	771.07	3287	771.11	56.	0.04

TABLE 5(d)

TAR CREEK

NET EFFECTS OF PROPOSED DIVERSIONS

Location	Return Frequency Years	WO/Diversion Peak Discharge CFS	WO/Diversion Elevation MSL	W/Diking & Diversion Peak Discharge CFS	W/Diking & Diversion Elevation MSL	Net Increase Due to Proposed Diversions Discharge CFS	Net Increase Due to Proposed Diversions Elevation Feet
G. At NW 22D Street on Trib Just East of Airport	100	993	785.17	1295	785.69	302	0.52
In an area susceptable to flooding damage before diversion work.	50	856	784.91	1125	785.42	269	0.51
	25	731	784.65	974	785.13	243	0.48
	10	586	784.34	784	784.76	198	0.42
	5	466	784.07	615	784.40	149	0.33
	2	329	783.61	422	783.95	93	0.34
	1	216	783.04	278	783.40	62	0.36
H. At Rockdale Avenue Above NEO	100	13566	763.11	14342	763.29	776.	0.18
Park land area.	50	11650	762.66	12235	762.80	585.	0.14
	25	10075	762.27	10500	762.39	425.	0.12
	10	8239	761.65	8499	761.74	260.	0.09
	5	6685	761.00	6855	761.08	170.	0.08
	2	4874	760.08	4971	760.16	97.	0.08
	1	3393	758.76	3448	758.82	55.	0.06

TABLE 5(e)

TAR CREEK

NET EFFECTS OF PROPOSED DIVERSIONS

Location	Return Frequency Years	WO/Diversion Peak Discharge CFS	WO/Diversion Elevation MSL	W/Diking & Diversion Peak Discharge CFS	W/Diking & Diversion Elevation MSL	Net Increase Due to Proposed Diversions Discharge CFS	Net Increase Due to Proposed Diversions Elevation Feet
I. At Steve Owens Blvd. Park land area.	100	13641	760.33	14414	760.55	773.	0.22
	50	11716	759.78	12298	759.95	582.	0.17
	25	10135	759.31	10557	759.45	422.	0.14
	10	8291	758.57	8549	758.67	258.	0.10
	5	6728	757.71	6899	757.82	171.	0.11
	2	4907	756.48	5003	756.57	96.	0.09
	1	3417	754.81	3472	754.89	55.	0.08

REFERENCES

1. Reed, W. W. Schoff, S.L. and Branson, C.C. 1955, Ground Water Resources of Ottawa County, Oklahoma, Oklahoma, Geological Survey Bulletin 72.

2. Site Investigation, Tar Creek Site, Ottawa County, Oklahoma, Oklahoma Department of Health, April 1983, EPA Grant No. CX 810192-0.

3. Site Feasibility, Tar Creek Site, Ottawa County, Oklahoma, Oklahoma Department of Health, January, 1983, EPA Grant No. CX 810192-0

4. Synopsis of Engineering Perspectives for Contamination Occurring in the Picher Mining District, Hittman Associates, Inc., Oklahoma Water Resources Board, January, 1982, Contract No. H-D8034-001-81-1042 FR.

5. Technical Release Number 61, WSPZ Computer Program, Engineering Division, Soil Conservation Service, U.S. Department of Agriculture, May, 1976.

6. Technical Release Number 20, Computer Program for Project Formulation, Hydrology, Engineering Division, Soil Conservation Service, U.S. Department of Agriculture, May, 1982.

ADDENDUM 4

ADDENDUM 4

Tar Creek Site
Ottawa County, Oklahoma

Remedial Alternatives Analysis

TAR CREEK GROUND WATER MONITORING PROGRAM

I. PURPOSE

The purpose of this addendum is to:

1. Review the Tar Creek Site Remedial Alternatives Analysis in areas discussing a post closure ground water level monitoring plan.
2. Describe in more detail a post closure ground water level monitoring plan.

II. INTRODUCTION

The Site Investigation report presented a description of the Tar Creek site hydrogeology. The following discussion only refers to the Boone and Roubidoux hydrogeology.

The Boone Formation is a Mississippian age cherty limestone averaging about 370 feet in thickness. Lead and zinc deposits of the Picher Mining District are found in various members of the Boone. Prior to initiation of large scale mine dewatering, the Boone was probably the major source of water for the local residents.

To maintain unsaturated conditions in the mine workings, large capacity sump pumps were used. Pumpage from the Boone varied with time and depth of mining. During World War II an estimated 14 mgd were discharged by the various mining operations. As the demand for lead and zinc declined after the war, pumpage declined to about 9 mgd as the lower grade ore present in deeper workings were abandoned (Reed, 1955). Pumping from the Boone continued until the mid-1960's when major mining ceased.

Water levels of the Boone recovered to their approximate pre-mining level by 1980 and began discharging at the surface in 1979. Recharge to the Boone system comes not only from natural infiltration, but also from direct surface water inflow to shafts, bore holes and collapsed structures.

The Boone contains solution openings which enhance the movement of ground water and produce large water yields from wells intersecting these passageways. A well not encountering any solution cavities or fractured zones might yield only moderate amounts of water. Transmissivity values as calculated by Hittman Associates, ranges between 45,000 to 75,000 gpd/ft for confined and unconfined conditions respectively.

III. ROUBIDOUX FORMATION

The Roubidoux Formation is a 160 foot thick sequence of Ordovician age cherty dolomite with several sandy sequences. This aquifer is the major water producer for Ottawa County. Depth to this aquifer is generally between 900 to 1000 feet in the mining area. Reed (1955) reported that wells completed in the Roubidoux flowed at the surface prior to 1918. The increased water withdrawals by the numerous mining and milling operations caused a lowering of the potentiometric surface of the Roubidoux, with pumping lifts reaching more than 500 feet by 1947. Water level decline within the Roubidoux apparently has stabilized, at least since 1975, based upon water level data obtained from the city of Miami, Oklahoma. Seasonal water level fluctuations can be observed; however, the potentiometric surface of the Roubidoux appears to have remained about 320 feet above msl around Miami, Oklahoma, since 1975.

Away from the major pumping areas, the potentiometric surface of the Roubidoux is higher. A well completed in the Roubidoux at the Eagle Picher Boron Plant had a reported water elevation of approximately 490 feet above msl.

Direction of ground water movement in the Roubidoux is not well defined; however, it is inferred to be in a generally westerly direction.

1. Aquifer Parameters

Data concerning aquifer testing in the Roubidoux are limited. Reed (1955) analyzed three pumping tests of Roubidoux wells at the B.F. Goodrich plant near Miami, Oklahoma, and determined an average transmissivity value of approximately 39,000 gpd/ft and a storage coefficient of 8×10^{-5}.

2. Water Quality

Ground water derived from Roubidoux wells generally has a total dissolved solids (TDS) concentration of less than 500 milligrams per liter (mg/l). Water from the Roubidoux is typically classified as a calcium-bicarbonate or a sodiumchloride type, based upon the milliequivalent concentration per liter of the major anions and cations. Dissolved metals are usually present only in trace amounts; however, a well at the Eagle Picher Boron Plant has reported high concentrations of dissolved metals, especially iron.

IV. Proposed Post Closure Ground Water Monitoring Plan

There are two separate monitoring programs recommended for implementation. These are the Roubidoux water quality monitoring program and the mine ground water level surveillance plan. The following is an outline of each program.

A. Roubidoux Aquifer Monitoring Plan

The following Roubidoux Aquifer Monitoring Plan is suggested as a possible measure to detect infiltration from the Boone Aquifer.

The municipal wells listed below are suggested as possible indicator locations for monitoring of the Roubidoux Aquifer:

Each well will be collected and analyzed twice each year, once in October and once in April for the following parameters:

a) pH
b) Iron
c) Manganese
d) Sulfate
e) Total hardness
f) Lead
g) Cadmium
h) Specific Conductance

B. Mine Ground Water Level Monitoring Plan

A ground water level surveillance program is suggested to determine success of diking and diversion work in preventing surface flow of mine discharges. The plan will entail monitoring the rates of spring discharge and ground water levels in selected nearby mines for two years after closure. Actual measurements of these parameters should be done at least four times a year with the greatest number of observations being collected during high ground water levels and/or after high precipitation events.

ADDENDUM 5

ADDENDUM 5

Tar Creek Site
Ottawa County, Oklahoma

Other Potential Sources of Funding

I. PURPOSE

The purpose of this addendum is to show there are no other available sources of funding for the proposed remedial action at the Tar Creek site.

II. DISCUSSION

The use of other sources of funding is pursued in an addendum provided by the Oklahoma Conservation Commission. This document describes in detail the uses of the Abandoned Mine Land Reclamation Fund and the Oklahoma Water Resources Board Revolving Fund, and their applicability to this project.

A. The Abandoned Mine Land Reclamation Fund

The Reclamation Fund is designed primarily to assist States in reclaiming abandoned coal areas. Oklahoma estimates that there are some 30,000 acres of coal areas tht will cost $100 million to cleanup. This program provides the 50 percent State contribution. The Oklahoma allocation is approximately $1 million per year for the next 15 years leaving a substantial deficit for the coal areas.

After the top priority coal areas are addressed, non-coal areas, such as a portion of Tar Creek project may be considered for surface work. If any funds remain after non-coal areas are reclaimed, abandoned underground mine workings may tap the fund.

B. The Oklahoma Water Resources Revolving Fund

The primary mission of this $25 million fund is to provide loans and grants to cities, towns and rural water districts for water and/or sewer improvements. The other purpose of the revolving fund is to make money available to be spent on water resource planning and research activities, State's cost-sharing on Federal water projects, construction of State water projects, and repayment of water supply storage contracts between the State and Federal governments. This fund will in fact be used by the State to provide the 10 percent cost-share for the remedial action.

The Oklahoma Water Resources Board is directed by law to manage and administer the fund so as to maintain a revolving fund balance adequate to sufficiently back any and all outstanding investment certificates. Because substantial amounts cannot be withdrawn from the fund at any one time, it would be virtually impossible to use the allocation for all of the construction costs on Tar Creek.

III. CONCLUSIONS

It is evident from the extensive materials presented by the State that the two funds cannot be used to conduct the entire remedial action at Tar Creek. The reclamation fund will be exhausted on coal areas and the revolving fund could not provide an outlay large enough to cover the total costs, although it will be used to provide the 10 percent State cost share required by CERCLA.

ADDENDUM 2

ENVIRONMENTAL PROTECTION AGENCY
AND
TAR CREEK TASK FORCE

Response to Comments on the Proposed
Remedial Alternatives for the Tar Creek Site
Picher Mine Field, Oklahoma and Kansas

COMMENT - ASARCO:

"Our principal concern is the intention to plug abandoned wells completely to the surface. While we understand that State regulations require plugging of contaminated wells to the surface, in this instance the practice is unnecessary to protect the drinking water supply and will waste a great deal of money."

"The purpose of plugging the wells is, as we understand it, to isolate the good quality water of the Roubidoux aquifer from the contaminated mine water in the Boone formation. Technically, this only requires that abandoned wells be plugged in the formations which separate these two aquifers. This would entail cleaning the well, if necessary, establishing a base in the Roubidoux on which to place the plug material, and injecting sufficient cement to fill the old well between the two foundations."

"The extra effort in plugging the wells the rest of the distance to the surface would additionally entail establishing another base of material or a bridge plug in the Boone and injecting sufficient additional cement to reach the surface. Strictly in terms of plugging, this additional, and technically unnecessary effort, could be as or more expensive than the necessary portion. In terms of overall cost, clearing the well can be a major expense or not, depending on the condition of the well. In any event, in the overall project, a very significant portion of the alotted costs will be spent in an activity which will lend no significant benefit. Because the well plugging portion of the recommended actions is projected to cost almost $2 million, this wastage could be very substantial."

"Therefore, we encourage the Task Force to modify the well plugging recommendation to only plug the abandoned wells to the extent necessary, that is, between the two aquifers and to petition the Water Resources Board to grant an exception from the State regulations to allow the project to be conducted on this basis."

RESPONSE:

A cost-effectiveness analysis was made to determine the costs associated with plugging the upper 250 feet (depth to the mine workings approximately 1/4 the total depth) of the abandoned wells which confirmed it is cost effective to plug that portion of the wells with the premix cement used in the process. Since the other cost for the well plugging operation are fixed, the only additional costs for plugging the upper portions of the wells are plugging material and the small amount of additional time required for the drill rig. Additionally, plugging of the wells to the surface will maximize contact between the well bore and the cement thereby providing a more reliable plug, as well as preventing those wells from possibly becoming discharge points. Therefore, based on the cost-effective analysis, it was determined that the additional technical reliability of the plugging procedure gained by plugging the wells to the surface is worth the minimal additional expense.

COMMENT - Dr. William Goodman, Mayor of Miami:

Dr. Goodman requested that the alternative water sources for Miami and Ottawa County be a pipeline from Grand Lake.

RESPONSE:

In response to Miami's desire to recommend a pipeline to Grand Lake, the EPA and the Oklahoma Water Resources Board will work with Miami and other municipalities to assure local needs are expressed, discussed and fully considered. The alternative water supply discussion developed in the Feasibility Study was prepared only for cost comparison and is not a recommended alternative. In the event an alternative water supply is required, all available options for providing drinking water will be reviewed and considered.

COMMENTS OF EAGLE-PICHER INDUSTRIES, INC. ON THE TAR CREEK FEASIBILITY STUDY AND "PROPOSED REMEDIES"

At a public briefing held on January 9, 1984, Governor Nigh released the Tar Creek feasibility study and announced the measures recommended by that study to address the environmental conditions at the Tar Creek, Oklahoma site.

In a January 10, 1984 press release, also announcing the completion of the feasibility study, the United States Environmental Protection Agency (EPA) stated that "EPA and the State recommend" a three point program "as an environmentally sound solution" to the conditions at the Tar Creek, Oklahoma site. The recommended three point program includes:

1. Plugging of abandoned water wells intersecting both the Boone and Roubidoux formations;
2. Construction of water diversions to prevent surface runoff inflows to the mines at specific locations in Kansas and Oklahoma; and
3. A groundwater monitoring program to assess the effectiveness of the well-plugging and diversion actions.

EPA's press release solicits comments on these "proposed remedies" by February 16, 1984.

These comments are submitted on behalf of Eagle-Picher Industries, Inc. (Eagle-Picher) in response to EPA's request for comments and address the "proposed remedies," the "Tar Creek Remedial Alternatives Analysis Information Package" apparently prepared by EPA and the 18 feasibility study reports prepared by the Oklahoma Water Resources Board, its contractors and the Tar Creek Task Force.*/

I. General Comments on the Feasibility Study and the Proposed Remedies

While Eagle-Picher has a number of specific technical and scientific comments on the feasibility study reports, Eagle-Picher believes the Task Force is to be generally commended for the work which has been done in connection with this study -- work which was accomplished under significant time constraints.

Throughout the verification and feasibility phases of the Task Force's effort, Eagle-Picher has endeavored to provide every assistance to the Task Force. In this regard Eagle-Picher has responded to all requests for information and scientific analysis made by the Task Force. Shortly after the data generated by the verification studies became available Eagle-Picher provided the Task Force with analyses of that data made by the company's experts. At that time Eagle-Picher suggested that the verification data demonstrated that both the scope and immediacy of the environmental problems at the Tar Creek site were considerably less than originally postulated by EPA's initial contractor's "report" on the site. Eagle-Picher also suggested that the verification studies indicated that it would be advisable to focus the feasibility study on the need for two particular measures at the site: diversion of surface run-off to prevent its entry into the mines; and a groundwater monitoring program to detect any possible future effect of the water trapped in the mines on the Roubidoux aquifer. Eagle-Picher's suggestion concerning diversion was based on the surface geography of the area and the correlation between precipitation events and mine water discharges. Eagle-Picher also considered that a groundwater monitoring program would be a prudent step even though the verification data did not demonstrate that mine water was currently entering the Roubidoux or that such entry was likely in the future.

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*/ These comments address the technical, scientific and policy issues raised by the feasibility study and "proposed remedies." These comments do not address the legal and factual issues presented by the use of the Comprehensive Environmental Response, Compensation and Liability Act of 1980 to fund the studies or proposed remedies. These issues have been addressed by Eagle-Picher in other communications and correspondence with EPA, most recently in Eagle-Picher's February 15, 1984 letter to Allyn Davis of EPA.

Eagle-Picher's review of the final verification and feasibility reports prepared by the Task Force and its contractors indicates that the Task Force has reached conclusions similar to those of Eagle-Picher concerning the scope and immediacy of the environmental problems at the site. Furthermore, the feasibility study endorses both of the measures suggested by Eagle-Picher for further consideration.

Although Eagle-Picher has several comments concerning the technical aspects of the Task Force's findings with regard to the scope of the problem and the advisability of instituting these two measures, the company generally agrees with these aspects of the Task Force's conclusions. Eagle-Picher continues to believe, however, that because the information presented in the results of the verification and feasibility studies do not indicate a threat of contamination of the Roubidoux Aquifer, Eagle-Picher questions the need for the well-plugging program suggested as a "potential remedy."

Detailed comments on the "proposed remedies," as well as other measures considered during the feasibility study, are included in the following sections of Eagle-Picher's comments. These comments first address three major issues raised by the feasibility study and the "proposed remedies": diking and diversion; Roubidoux contamination and the need for well-plugging;

and treatment of mine water. Eagle-Picher then comments on particular statements contained in the Tar Creek Remedial Alternatives Analysis Information Package and several of the reports on individual feasibility study tasks.

II. Diking and Diversion

The feasibility of a program of diking and diversion to prevent the entry of surface run-off into the mines is addressed in five separate reports:

1. Task II.3 - Diking and Diversion Feasibility Study;
2. Task II.3.C - A Preliminary Identification and Description of Diking and Diversion Techniques;
3. Task II.3.D - Assignment of Appropriate Alternatives to Inflow Points;
4. Task II.3.E.a-e - Estimated Diversion Costs; and
5. Task II.3.E.f - Assessment of Changes in Drainage Patterns Resulting From Proposed Diversion and Diking

Eagle-Picher has long suggested that, because outflow of mine water is strongly correlated with precipitation events, the diversion of surface run-off to prevent its entry into the mines could prevent the discharge of mine water to the surface. Consequently, Eagle-Picher generally agrees with the recommendations of the feasibility study concerning diking and diversion. Several comments are, however, in order.

Eagle-Picher generally agrees with the methodology used to assign diking and diversion priorities to the various identified inflow points. Eagle-Picher also agrees with the Task Force's recommendation to undertake diking and diversion only at those sites which contribute a significant percentage of the total surface run-off reaching the mines.

On the basis of its assignment of priorities, the Task Force has recommended diking and diversion at three sites:

1. Site K-1 (Muncie);
2. Site K-2 (Big John); and
3. Site O-3 (Admiralty No. 1 and No. 2).

In discussing diversion at Site O-3 the report entitled "Assignment of Appropriate Alternatives to Inflow Points" states, at page 2:

> Both openings [Admiralty No. 1 and No. 2] could easily become inflow points. Therefore, diversion of surface flow away from these points is necessary if any diversion work is to be done.

[Emphasis added]

The estimated cost for diking and diversion at Site O-3 given in the report entitled "Estimated Diversion Costs" is $850,000.

This represents a full 50 percent of the total estimated cost of diking and diversion at the three sites.

Therefore, as Eagle-Picher understands the feasibility study reports, the Task Force is recommending an $850,000 diking and diversion program at a site which only "could" become an inflow point as a result of diking and diversion at the two other sites. Eagle-Picher suggests that it is not cost effective to currently commit to diking and diversion at Site O-3 simply on the basis that it "could" become an inflow point. Rather, diking and diversion should be undertaken at Sites K-1 and K-2. Following completion of diking and diversion at these sites an evaluation should be made to determine whether or not Site O-3 actually becomes an inflow point. If so, diking and diversion can then be undertaken at Site O-3.

III. Roubidoux Contamination and the Need for Well Plugging

The feasibility studies recommend the plugging of 66 abandoned water wells which intersect both the Boone and Roubidoux formations. Eagle-Picher questions whether the information currently available justifies a well plugging program at this time.

This recommendation is apparently based on the conclusion of the Task Force that mine water is either currently contaminating the Roubidoux or theatens to do so in the near future. Thus, for example, the Tar Creek Remedial Alternatives Analysis Information Package states, on page 11:

> Mine waters are being introduced into the Roubidoux via abandoned wells.

Other reports of the results of the feasibility study make similar statements. Very little evidence has been adduced to support this most important conclusion. What little available information has been referenced in either the verification phase reports or the feasibility study reports does not support the conclusion either that mine water is currently entering the Roubidoux or is likely to do so in the future.

Similar statements concerning Roubidoux contamination were made in the verification phase reports. In those reports two pieces of information were cited in support of the conclusion that mine waters were currently contaminating the Roubidoux. First, the reports contended that spinner logs demonstrated downward migration of mine water through abandoned wells. Second, the verification reports contended that water sampling of a few isolated wells indicated mine water contamination of the Roubidoux. In its comments on the draft verification studies

Eagle-Picher extensively analyzed the information presented in support of the Roubidoux contamination theory and demonstrated that the information did not support the conclusions reached. These comments need not be repeated here.

In the feasibility studies two additional pieces of information are cited in support of the Roubidoux contamination theory. First, the reports contend that TV logs of abandoned wells demonstrate Roubidoux contamination by mine water. Second, the head differential between the Boone and Roubidoux formations is cited as increasing the "chances" of mine water contamination of the Roubidoux. For example, the Identification and Assessment of Potential Remedial Alternatives states, at page 2:

> As increasing head differential drives water toward the Roubidoux, the chances of acid mine water pollution in this important aquifer increases [sic].

Turning first to the TV logs, the actual report of the well plugging contractor does not state or support the theory that the TV logs demonstrated that mine water was entering the Roubidoux. Rather, the contractor's report simply states that the TV logs showed mine water entering abandoned wells through holes in the well casing. The report made no claim that the TV logs demonstrated that this mine water actually reached and contaminated the Roubidoux. See Feasibility of Clearing and Plugging Two

Abandoned Roubidoux Water Wells, at page VI-3. Furthermore, as Eagle-Picher has pointed out in the past, the fact that mine water enters abandoned wells through holes in the casing does not mean that the mine water reaches or contaminates the Roubidoux. Indeed, mine water entering the casing would have a difficult, if not impossible, job in reaching the Roubidoux. In all wells, whether active or inactive, there would be a static head of Roubidoux water at an elevation higher than the normal geological strata of the Roubidoux. This static column would act as a barrier or a resistor to a free-flowing, co-mingling of downward moving mine water into the Roubidoux. Furthermore, as Eagle-Picher has previously pointed out, natural chemical reactions confirmed by the Task Force's verification study would act to prevent contamination of the Roubidoux by any mine water which happened to reach the aquifer through abandoned wells.

In addition to the TV logs, the feasibility study reports cite the head differential between the Boone and Roubidoux formations as a force potentially driving mine water to the Roubidoux. It should be noted at the outset that no scientific data is adduced to support this theory. Furthermore, the geophysical conditions in the area indicate that head differential is not a cause of Roubidoux contamination. Indeed, if the head differential was driving mine water to the Roubidoux the level of the

Roubidoux aquifer would be considerably higher and the head differential considerably less. In addition, the existence of surface discharges indicates that any flow down the wells is not sufficient to establish equilibrium with the inflow or resupply. Consequently, there is no evidence that head differential is acting to drive mine water to the Roubidoux.

Eagle-Picher considers the issue of Roubidoux contamination to be critical. The Task Force's recommendation for well-plugging is based on the conclusion that such contamination either is occurring or is likely to occur in the near future. For the reasons discussed both above and in Eagle-Picher's comments on the verification study reports, Eagle-Picher does not believe that the information available to date demonstrates either that mine water is currently contaminating the Roubidoux through abandoned water wells or that such a phenomenon is likely to occur in the future. Under such circumstances, Eagle-Picher questions whether the well-plugging program proposed by the Task Force is justified. Eagle-Picher recognizes that the well plugging recommendation may be a result of what the Task Force considers an "abundance of caution." Eagle-Picher submits that an expensive, questionable program should not be based on a concept of what "might happen" but only on the presence of a demonstrated threat. Furthermore, Eagle-Picher does not believe that CERCLA properly may be used to finance efforts to remedy undemonstrated threats. Therefore, while Eagle-Picher understands the motivation of the Task Force in recommending well plugging, we believe a well plugging program is, at best, premature. Rather, as previously suggested by Eagle-Picher, a thorough "early warning" monitoring program should be undertaken to answer this most important question once and for all. Only when information sufficient to demonstrate conclusively that mine water intrusion into the Roubidoux through abandoned water wells is occurring or is likely in the near future should the proposed well plugging program go forward.

In addition to attempting to justify a well plugging program the feasibility study reports also include a discussion of the technical feasibility of such a program. This discussion is contained in a report entitled "Feasibility of Clearing and Plugging Two Abandoned Roubidoux Water Wells" (Task II.2). Eagle-Picher has already discussed the need for a well plugging program. Therefore, Eagle-Picher's comments on the report concerning the feasibility of such a program will be limited to technical issues which should be considered if and when a well plugging program is to be undertaken.

Generally, Eagle-Picher finds the report of the Task Force contractor to be complete. Eagle-Picher believes, however, that in translating a pilot program to a full-scale well-plugging operation, the basic objective of the program must be kept in mind. A well-plugging program has but one objective -- the secure closing of the wells to be plugged at the lowest possible cost. Because the conditions to be encountered at the wells to be plugged will vary, a flexible approach to the program which keeps the general objective in mind is essential. In particular, three parts of the program should receive careful scrutiny at each well site.

First, the contractor's report suggests that wells will be cleared of obstructions before plugging in every case. Eagle-Picher submits that the clearing of obstructions will add considerable cost to the well-plugging operation and should be undertaken only in cases where it is determined that the obstruction will significantly interfere with the construction of a secure plug. Since the object of the exercise is to plug the well there is absolutely no need to remove obstructions unless they interfere with that objective. Furthermore, consideration should be given to driving obstructions to the bottom of the well before it is determined that clearing is necessary in a particular case.

Second, the type of equipment necessary to complete any clearing which may be necessary should be given careful consideration on a case-by-case basis. Eagle-Picher suggests that the use of cable tool equipment be given priority consideration in each case. Cable tool equipment is lighter and cheaper. Furthermore, such a rig would not require the large amounts of water to remove cuttings projected by the contractor's report. Only in cases where cable tool equipment cannot be used should the use of heavier, more expensive and more water demanding equipment be considered. Furthermore, consideration should be given to either baling cuttings or allowing them to drop to the bottom of the well to augment or replace the sand fill suggested by the contractor.

Third, careful consideration should be given to the necessity for logging the plugging operations. Since the sole objective is to plug the well only that logging absolutely necessary to that purpose should be undertaken. There is little need to gather geophysical data for its own sake when the objective is well-plugging. In this regard, Eagle-Picher suggests that there are probably no circumstances in which Spontaneous Potential, Single Point Resistance and Normal Resistivity logs should be run. In addition spinner logs should not be considered because information available through spinner logs is either irrelevant to a well plugging operation or can be gathered more efficiently by other logging techniques.

Beyond these basic concerns, Eagle-Picher suggests that certain technical considerations should be reviewed prior to initiation of a well-plugging program. First, Eagle-Picher does not believe that the available data concerning sulfates justifies the use of Class H cement. Class A cement should be sufficient. Second, Eagle-Picher notes that the contractor's report suggests that cellophane flakes be used to prevent loss of cement. It has been the experience of the experts retained by Eagle-Picher that the use of cellophane flakes for this purpose is ineffective.

The contractor's report also recommends the placement of a plug at the top of the Roubidoux formation in every case. Based on their knowledge of the nature of the Cotter and Jefferson City formations in the area, Eagle-Picher's experts see little or no benefit to the placement of such a plug in all cases.

The contractor's report also recommends the use of "fast set additives" in cementing plugs. Eagle-Picher's experts believe that the cost of such additives cannot be justified unless cement loss becomes a real problem in a particular plugging operation.

Finally, Eagle-Picher is somewhat perplexed by the total cost estimate of $1,951,900 for the plugging of 66 wells. This total estimate appears to be considerably higher than that obtained by multiplying the estimated "worst case" per well plugging cost by the 66 wells involved.

IV. Treatment of Mine Water

The treatment of mine water is a major issue which is addressed in a number of the feasibility study reports. Six reports address this alternative specifically:

1. Task II.1.A - Identification and Assessment of Potential Remedial Alternatives;
2. Task II.4.A.a - Evaluation of Treatment Alternatives, Review of Water Quality Data . . .;
3. Task II.4.A.b - Evaluation of Treatment Alternatives, Development of Water Quality Goals for Treated Acid Mine Water;
4. Task II.4.A.c-e and g - Evaluation of Treatment Alternatives, Identification of Treatment Technologies and Development of Costs;
5. Task II.4.A.f - Development of Appropriate Management Plans for Sludge Production in the Treatment Process; and
6. Task II.4.A.h - Assessment of Environmental Impacts and Legal Aspects (including permits) Associated With the Treatment Alternatives

It is Eagle-Picher's understanding from a review of all of the feasibility study reports that the alternative of pumping and treating all of the water currently trapped in the mines has been rejected both because it is not cost effective and "there is also no guarantee of the degree of success that would be accomplished." Task II.1.A, Identification and Assessment of Potential Remedial Alternatives, at 19. Eagle-Picher has long maintained that the pumping and treatment of the water trapped in the mines is infeasible and, indeed, impossible. Furthermore, such a plan is likely to produce more problems than it solves as it would require the disposal of stupendous amounts of metal contaminated sludge and would produce a high risk of further subsidence and other geological effects in the Tar Creek area. Consequently, Eagle-Picher agrees with the Task Force's rejection of the pump and treat alternative.

Even though the Task Force has rejected the concept of pumping and treating all the mine water, one point should be made concerning the Task Force's evaluation of this alternative. In discussing the feasibility of pumping and treating the acid mine water the feasibility reports use a plant design capacity of two million gallons per day (mgd). This figure was based on a calculation of the recharge rate of the Boone formation. The 2 mgd figure was arrived at by taking five percent of the annual precipitation of 40 inches "for the area" as the Boone formation recharge rate. Eagle-Picher submits that this calculation is overly simplistic and may considerably underestimate the size of the treatment plant necessary to pump and treat all of the water trapped in the mines. First, a plant sized to accommodate only the annual recharge would not result in any draw down of the water currently in the mines. While Eagle-Picher recognizes that excessive draw down would not be desirable, some draw down would be necessary if treatment were to accomplish any more than natural processes in the elimination of mine water.

Even more importantly, Eagle-Picher believes that the computed 2 mgd plant capacity significantly underestimates even the recharge rate and would result in a treatment plant considerably undersized for the job. The 2 mgd figure was based on a percentage of annual precipitation "for the area." There is no evidence to suggest that the Boone formation recharge zone is limited to or even includes the "area" in question. Furthermore, Eagle-Picher has extensive experience in efforts to dewater mines in the Boone formation. These dewatering operations indicated that the recharge rate of the Boone formation is considerably higher than 2 mgd and could approach a range of 3.6 - 8.6 mgd. Consequently, any treatment plant based on a 2 mgd design flow would be considerably undersized even for the job postulated by the report. Thus, the pump and treat alternative is even less feasible than the study reports indicate (indeed, as discussed below, Eagle-Picher does not believe that meaningful treatment of mine water is even possible).

While the Task Force has rejected the concept of pumping and treating all of the water trapped in the mines, the feasibility study reports indicate that the Task Force has not rejected the alternative of collecting and treating some portion of the mine water should the diking and diversion program not entirely prevent the surface outflow of mine water. A possible method for such treatment is discussed in the report entitled "Task II.4.A.c-e and g - Evaluation of Treatment Alternatives, Identification of Treatment Technologies and Development of Costs." However, the feasibility study reports taken as a whole do not clearly indicate how the treatment alternative is being viewed by the Task Force. The report on Task II.7.A, "Preliminary Optimal Alternatives for the Superfund Program at Tar Creek Oklahoma," seems to indicate that collection and treatment of outflow which may remain after diking and diversion is a "contingency plan" which will be implemented in accordance with the system outlined in the feasibility reports should outflow continue after diking and diversion. On the other hand, the "Tar Creek Remedial Alternatives Analysis Information Package" proposes "that feasibility studies again be initiated to evaluate the problem" if diking and diversion is not completely effective to prevent outflow. This would seem to indicate that collection and treatment of remaining outflows has not been decided upon but will require further study.

Eagle-Picher does not believe that the studies conducted to date demonstrate the feasibility of collecting and treating any portion of the mine water. Indeed, the available information, including particularly Eagle-Picher's own experience in attempting to treat mine water, demonstrates that the treatment of such water on any scale is not feasible. In any event, and at a minimum, it is clear that the feasibility study conducted to date does not demonstrate that such treatment is feasible and does not take into consideration a number of factors which are important to making a determination of feasibility. Therefore, treatment of remaining outflows cannot be considered a feasible option as a "contingency plan" for the future. Further investigation and study is plainly required before treatment could be considered a feasible alternative. As discussed below, Eagle-Picher believes that treatment of mine water is not feasible and that any further relevant study would continue to demonstrate this to be the case.

It is important to note at the outset that the Task Force's entire consideration of the feasibility of the treatment of mine water is based on a series of "conventional" jar tests. Task II.4.A, "Evaluation of Treatment Alternatives, Identification of Treatment Technologies," at page 15. Eagle-Picher submits that such jar tests are not sufficient to establish the feasibility of the treatment of mine water. Eagle-Picher has a good deal of experience, not with jar tests, but with the actual treatment of mine water by the chemical precipitation methods recommended in the feasibility study. This full scale treatment experience has been obtained primarily in connection with the dewatering of mines in the area. This experience demonstrates that the treatment of mine water is simply not feasible.

The history of two of these mine dewatering projects will suffice to demonstrate the infeasibility of the treatment of mine water. It is interesting to note that both of these projects began with jar tests of the mine water similar to those conducted by the Task Force. On the basis of these jar tests it was determined by the appropriate state officials that mine water generated during dewatering operations could be discharged to surface waters without treatment. As the dewatering operations began, however, it became apparent that chemical reactions occurring in the real world (but not in jar tests) made it impossible to discharge mine water without treatment.

As a result of these findings, an extensive program was undertaken to design and construct mine water treatment facilities. The facilities eventually constructed consisted of a treatment train quite similar to that proposed by the feasibility study reports, with the important addition, in the Eagle-Picher system, of an aeration step which is not recommended by the feasibility study. Even with the additional aeration step, however, the treatment system was never able to achieve the effluent characteristics predicted by the feasibility study, particularly for iron. Eagle-Picher's experience indicates that treatment of mine water by chemical precipitation is not feasible because the lime slurry treatment system has a masking effect on oxidation which produces additional oxidation after the treated supernatent liquid leaves the system and enters the receiving stream.

Of course, it is well known that treatment efficiencies obtained in the laboratory on a small scale do not necessarily reflect the efficiencies which can be obtained in the field during full scale operations. In summary, based on available information concerning actual full scale treatment operations and not simply bench scale jar tests, treatment of mine water by chemical precipitation is not a feasible remedial alternative.

Even if there were no available information concerning full scale treatment of mine water, the feasibility study reports fail to take into consideration several factors which are crucial to determining whether or not such treatment is feasible. Therefore, treatment of mine water by chemical precipitation cannot be considered as a demonstrated feasible technology based on the studies done to date by the Task Force.

First, the feasibility and cost of treatment has been determined on the basis of a need for treatment for a period of 30 years. The reports of the feasibility study nowhere discuss the basis for this assumption. Other available information, however, indicates that this assumption is completely inaccurate. During the verification stage of the study the Task Force calculated that there were some 76,000 acre feet of water in the mines. The Task Force further calculated that it would take 60 to 100 years for the mines to drain at the current outflow rates. Assuming that diking and diversion will, at a minimum, significantly reduce the outflow rates (Eagle-Picher believes it will prevent further outflow), it will take considerably more than 60 to 100 years for the mines to drain. Therefore, the projection that treatment will be required for 30 years is a gross underestimate.

Even more importantly, the Task Force's calculation that it will take 60 to 100 years for the mines to drain is based on the assumption that the production of acidic mine water has ceased. There is absolutely nothing in the record of the studies to support this assumption. In fact, the chemistry of acid water formation in the Picher Mining District has received little attention and is virtually unknown. Until this phenomenon is studied and characterized it is simply impossible to assume that any treatment which is required will be other than in perpetuity. As a result of the failure to consider these two factors, the estimated cost of treatment and, therefore, its feasibility is completely unrealistic.

Second, the failure to consider a number of required capital items has resulted in a gross underestimate of the capital cost of treatment facilities. To cite but two examples, the feasibility study reports estimate the cost of a flow equalization basin to be $101,455. However, this estimate considers only the cost of land acquisition, excavation and the purchase of clay for a liner system. Actual construction costs for the basin as well as operation and maintenance costs necessitated by the presence of a liner and a leachate collection system have not been included.

Even more importantly, the capital cost estimates completely ignore the need for a mine water collection system. Depending upon the volume and location of any outflows remaining after the completion of the diking and diversion program, the cost of such a collection system could be very substantial.

Before the feasibility of mine water treatment can be evaluated the full construction costs associated with such an alternative must be calculated and analyzed.

Third, the yearly maintenance costs of a mine water treatment system have also been grossly underestimated. The estimates for chemical costs were based on the results of the jar tests conducted by the Task Force. However, Eagle-Picher's experience with the actual full scale treatment of mine water demonstrates that the lime slurry treatment technique is very inefficient and requires a great excess of lime over stoichiometric quantities. It is estimated that the projected chemical cost is understated by a factor of three or more times.

Fourth, the Task Force, again based on jar tests, has estimated the amounts and constituents of sludge which will be generated by the treatment process. Eagle-Picher's experience indicates that the actual amounts of sludge which will be produced will be far in excess of those projected on the basis of jar tests. Furthermore, the characterization of the sludge as "non-hazardous" on the basis of jar tests is an unwarranted assumption.

The composition of the sludge was calculated based on the composition of a discrete mine water sample which did not characterize the entire water column within the mines. Thus, on the basis of this sample, it is impossible to say with any degree of certainty that the sludge will be "non-hazardous."

V. Comments on Particular Statements in the Feasibility Reports

A. Tar Creek Remedial Alternatives Analysis Information Package

It appears that this document has been prepared by EPA as a summary of the findings of the feasibility study. As a summary this report should accurately reflect the statements, analyses and conclusions presented in the feasibility study reports. This report is not an accurate summary of the feasibility study in a number of important respects.

First, in the section on "problem definition" on page 3 the Information Package states:

> Waste materials (gob) containing iron sulfide (pyrite) were left in the mines, presumably as floor level waste piles. These pyrite-rich wastes were being oxidized by exposure to the oxygen-rich atmosphere while mining was occurring. Upon flooding, these oxidized sulfides readily dissolved and, once submerged, formed mine water.

This statement is unsupported and inaccurate. Further, it does not represent an accurate summary of the findings of the verification and feasibility studies.

In its comments on the draft verification studies, Eagle-Picher addressed a similar comment appearing on page 18 of the "Water Quality Assessment of the Flooded Underground Lead and Zinc Mines of the Picher Field in Ottawa County, Oklahoma." As Eagle-Picher's comments pointed out not one shred of evidence has been adduced to support the statement that waste materials were deposited in the mines. Certainly, at no time did Eagle-Picher, during the course of its mining operations in the Tri-State Mining District, ever deposit or leave "floor level waste piles" or other waste rock in the mines it was operating. All ore broken in the mines was transported to the surface for milling. No "high-grading" or other practices resulting in waste rock being left behind were practiced by Eagle-Picher. The scope of Eagle-Picher's operations would have made such practices uneconomical. Consequently, Eagle-Picher strongly objected to the inclusion in any of the verification study reports of statements to the effect that waste rock was left or deposited in the mines, unless such statements were supported by cited evidence and were specifically identified to those alleged to be responsible for the practice of leaving waste rock in the mines.

Review of the final verification and feasibility reports indicates that statements in the draft reports concerning "waste piles" in the mines were deleted from the final reports.

Consequently, the information package is not an accurate summary of the feasibility reports in this regard. Eagle-Picher again objects most strongly to this statement unless it is documented and specifically identifies the parties alleged to be involved.

Second, in the section on "surface water impacts" on page 5, the information package makes the following statement:

> The greatest threat to human health comes from possible dermal exposure to mine water from direct contact.

No incident of "dermal exposure . . . from direct contact" is documented in any of the reports of the Task Force. Nor is the "threat" of such exposure mentioned in the Task Force reports, probably because any such threat is so remote as to be infinitesimal. Consequently, the information package is not an accurate summary of the feasibility reports in this regard.

Third, in the section discussing "proposed actions" on page 14, the information package states:

> The well-plugging program will consist of clearing the hole of obstructions and setting an acid resistant cement plug from bottom to top . . . in some eighty abandoned Roubidoux wells.

The feasibility study reports on the well-plugging program call for the plugging of 66 rather than 80 wells. Thus, the reference to 80 wells in the information package is inaccurate.

B. Task II.1.A Identification and Assessment of Potential Remedial Alternatives

Among other things, this report addresses the core sampling done by the Task Force during the verification stage of the study. On page 11 the report states:

> The major portion of the core has low permeability, but some sequences have high permeability.

Eagle-Picher submits that this sentence is in error because none of the cores sampled showed "sequences" with high permeability.

In discussing the wells which have been drilled intersecting mine drifts in the Tri-State Mining District, the report states:

> There is no information to suggest that these wells were plugged as Reed suggested.

Eagle-Picher believes that this statement is in error because records have been provided to the Oklahoma Water Resources Board which demonstrate that approximately one-third of the 100 referenced wells have been plugged.

C. Task II.1.B.d - Effects of No Action Alternative Including the Results of Sediment Core Sampling in Upper Grand Lake

In discussing the no action alternative on page 4, the report states:

> On several occasions, water quality standards in the Neosho River have been violated due to acid mine discharges.

Eagle-Picher submits that this statement is inaccurate and is not supported by the available data which do not demonstrate "water quality violations" in the Neosho "due to acid mine discharges." Furthermore, this statement contradicts the statements made on page 37 of the Task Force's report on Task 1.1, dated February 1983.

Dated: February 16, 1984

RESPONSE TO EAGLE-PICHER COMMENTS

Diking and Diversion Program

Comment: Eagle-Picher contends that diversion work is not warranted at site O-3 because of the uncertainty involved with it becoming an inflow point.

Response: Data collected in the Feasibility Study concluded that the O-3 well will become an inflow point. However, because the geohydrology of the site is extremely complex, ground water levels may not recede enough to ensure surface flow into O-3. Therefore, diversion work will be completed at K-1 and K-2 in order to assess the impact at O-3. Funds will be provided to conduct the O-3 work since the impact should become apparent within one year.

Well Plugging Program

Comment: Little or no information exists to document the justification for plugging 66 abondoned Roubidoux water wells.

Response: Two studies, one done by USGS and the other done in the feasibility phase, showed migration of acid mine water into the Roubidoux via abandoned wells. In the USGS studies, spinner logs on two wells showed water moving from the Boone formation into the Roubidoux. The feasibility studies showed similar results obtained on the wells that were plugged for pilot program. In addition, in the latter investigation, TV logs revealed acid mine water entering through corroded casings. Because there is a net gradient difference between the potentiometric surfaces of the two formations (the Boone having a higher head than the Roubidoux) the movement of water is downward. Ground water investigations conducted by the USGS and Hittman have documented the existence of such a head differential.

Further evidence of impacts to the Roubidoux from acid mine drainage is the abandonment of two city wells serving Quapaw because of elevated iron level.

Comment: Clearing of obstructions will add considerable cost to the well plugging operation and should be undertaken only in cases where it is determined that obstructions will significantly hinder the construction of a secure plug.

Response: The primary objective of the well plugging program is to isolate the Roubidoux from the Boone in all 66 abandoned Roubidoux wells. To accomplish this objective, considerable effort will be expended to clear the individual wells of all obstructions. Clearing obstructions is necessary to insure a secure plug from top to bottom consistent with State requirements for well plugging. If it is not cost-effective for some of the wells to have obstructions removed, then an alternative such as a bridge plug may be necessary and considered.

Comment: Careful consideration should be given to the type of equipment necessary to complete the well plugging program.

Response: The type of equipment necessary to complete the well plugging will be determined in the design phase. The most cost-effective technique will be selected.

Comment: There is no need to conduct spontaneous potential, single point resistance, normal resistivity, and spinner logs for the well plugging program.

Response: Well logging is essential to the plugging operation. Variables such as type of geological materials, size of boreholes, position of obstructions, zones of contamination, etc., will be defined to ensure an adequate plug. The specific types of logs required by certain conditions are detailed in the Engineering Enterprises Feasibility Study.

Comment: Class A cement should be used instead of Class H cement.

Response: In the well plugging pilot study, a mixture of Class A and Class H cement was found to be the best. The Class H cement is necessary to prevent expansion and fracturing due to high sulfate concentrations. This mixture will be used for the final well plugging program.

Comment: There is no benefit to be gained from the placement of a plug at the top of the Roubidoux or using "fast set additive" in the cement.

Response: Every effort will be made to plug wells from bottom to top. The reason is that this type of plug will be the most secure and therefore has less probability for collapse. In some wells where the Roubidoux cannot be reached because of obstructions, a bridge plug may be utilized.

The fast set additives will be necessary to prevent slurry loss into previous strata. This will reduce the chance of extreme cement loss and therefore be more cost-effective than providing no such additives.

Comment: Multiplying the worst case cost estimates by 66 wells does not give the total cost estimate of $1,951,900.

Response: The $1,951,900 encompasses not only costs for the wells plugging construction, but constitutes additional funds for design, management oversight (consultants and States) and contingency.

Treatment of Mine Water

Comment: The pump and treat alternative is even less feasibile than the screening of alternatives report indicates.

Response: The pump and treat alternative was evaluated in the screening stage of the feasibility study. This alternative was eliminated from further evaluation because of technical constraints and the high costs of implementation. Had the alternative been selected for detailed analysis, the variables critical to proper operation would have been investigated more thoroughly.

Comment: It is infeasible to treat acid mine water that discharges to the surface.

Response: Past case histories have shown a high degree of success in treating acid mine water discharges by chemical neutralization techniques. The proposed alternative should prevent significant acid mine water discharge. If a problem persists after completion of the remedial action, treatment of acid mine discharges will be reevaluated to determine its applicability based on the collected monitoring data. This would mitigate discharges of contaminated acid mine water into the surface waters of Tar Creek, if any persist.

Comment: Based upon the amount of water in the mines, 30 years is inadequate to treat all the contaminated water.

Response: Thirty years of operation and maintenance does not represent the amount of time required to treat all the acid mine water discharges. Instead, it is an estimate of the average life expectancy of a treatment system. Another treatment system might be needed to replace the old one, if discharge of acid mine water continues beyond 30 years.

Comment: There is no evidence for cessation of acid mine water production.

Response: Because the mine systems are currently flooded, an important element is absent from the environment that existed when the mines were exposed. That element is oxygen. Now that reducing conditions are prevalent in these zones where high sulfides are concentrated, there is no driving mechanism to produce H_2SO_4. Therefore, it is unlikely that further acid mine water will be produced.

Comment: The cost for the treatment system has been underestimated.

Response: As mentioned, feasibility studies will be initiated again if surface discharge of acid mine water continues. This means that if treatment is deemed necessary, a detailed cost analysis would be conducted.

Comment: Samples collected for the jar tests are unrepresentative of the entire water column within the mines.

Response: Samples were collected from coreholes penetrating the mine workings and are the sites where they will be collected for future treatment, if deemed necessary.

Remedial Analysis Alternative Report

Comment: The following statement on page 3 is inaccurate:

> "Waste materials (gob) containing iron sulfide (pyrite) were left in the mine, presumably as floor level waste piles. These pyrite-rich wastes were being oxidized by exposure to the oxygen-rich atmosphere while mining was occurring. Upon flooding, these oxidized sulfides readily dissolved and, once submerged, formed mine water."

Response: This statement was revised in the final version of the document to read "pyrite-rich materials were being oxidized by exposure to oxygen-rich atmosphere when mining was occurring. Upon flooding of the mine workings, these oxidized sulfides readily dissolved and when submerged, formed acid mine water."

Comment: Chances are "infinitesimal" in regards to direct contact with acid mine water in Tar Creek.

Response: Anytime there is a condition whereby hazardous wastes are exposed, there is a chance for direct contact. In the case with Tar Creek, the direct contact route is enhanced because it is readily accessible and near several populated areas. Tar Creek has been shown to be used by local residents for recreational purposes.

Comment: The Remedial Alternative Analyses report contradicts the feasibility report in the number of wells to be plugged.

Response: The draft ROD package was formulated before the feasibility studies were complete. The initial estimate of the number of unplugged wells was 80. This number was later refined to 66 wells. The ROD has been changed to reflect 66 wells needing plugging.

Assessment of Potential Remedial Alternatives

Comment: The following statement in the feasibility report is in error:

> "The major portion of the core has low permeability but some sequences have high permeability."

Response: The reference from which this statement was made came from Task I.D. of the Investigation Report. This report states that although cores evaluated have low permeabilities, there are undoubtedly zones in the Roubidoux capable of producing high water yields. These zones are responsible for producing much of the Region's potable water.

Comment: Some of the abandoned Roubidoux wells have been plugged, as proved in records sent to the Oklahoma Water Resources Board.

Response: The statement to which the comment was addressed has been revised to say some of the wells have indeed been plugged.

No-Action Alternative

Comment: The report states that water quality standards have been violated in the Neosho River. This is an inaccurate statement.

Response: Zinc has been found to exceed Oklahoma's water quality standard of .463 mg/l on a few occassions. The drinking water quality standard of 5 mg/l has not been exceeded. The State of Oklahoma also recognizes aesthetics as an integral part of the State's water quality standards.

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February 15, 1984

Allyn M. Davis, Director
Air and Waste Management Division
United States Environmental
  Protection Agency
Region VI
1201 Elm Street
Dallas, TX 75270

Re: Tar Creek Mining Site,
Ottawa County, Oklahoma

Dear Mr. Davis:

This is in response to your letter of December 20, 1983 to Mr. John Wade of Eagle-Picher Industries, Inc. (Eagle-Picher) and the discussions at the meeting of January 16, 1984 concerning the Tar Creek, Ottawa County, Oklahoma situation.

As we discussed at the January 16, 1984 meeting, while Eagle-Picher denies that it is a "potential responsible party" or otherwise liable under the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA) for "investigating and controlling" alleged "releases of hazardous substances, pollutants and contaminants" at the Tar Creek, Oklahoma site*/, the company has always been prepared to discuss what measures may be advisable at the site and who should participate in the initiation and funding of those measures.

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*/ The rationale underlying Eagle-Picher's views on CERCLA liability has been stated in previous correspondence and conversations and need not be repeated here.

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Eagle-Picher has participated actively in assisting Governor Nigh's Tar Creek Task Force in the investigation and studies undertaken by the Task Force in an effort to define the scope of the problem and any measures which may be feasible and advisable.

While Eagle-Picher has been able to work closely and effectively with the Task Force, the company has been unable to advance the discussions being directed by EPA concerning who should participate in the execution of any measures ultimately deemed to be advisable. The failure of these discussions to make progress is due entirely to EPA's refusal to acknowledge and act upon two facts which are central to the resolution of this matter.

First, EPA has failed to recognize the complexity of the "responsible party" issue in this matter which involves hundreds of mineral owners and mining companies who participated in the development of the Oklahoma portion of the Tri-State Mining District over its 70-year history of operation.

At the demand of EPA and at considerable expense to Eagle-Picher, the company has provided the agency with a significant amount of information, including certified land ownership records, identifying a large number of current landowners, royalty recipients and operating companies. Despite this information EPA has, to date, identified only a handful of what EPA officials attending the January 16, 1984 meeting described as "mine operators" as "potential responsible parties." At the January 16, 1984 meeting EPA also stated its refusal to even consider identifying landowners who received mining royalties as "potential responsible parties." EPA's continued failure to recognize that development of mining in Ottawa County involved many more individuals and companies than the handful so far identified by EPA is unreasonable, unfair and in dereliction of EPA's clear duty as a federal agency charged with enforcement of important federal laws.

TABLE 5b

TAR CREEK

NET EFFECTS OF PROPOSED DIVERSIONS

Location	Return Frequency Years	WO/Diversion		W/Diking & Diversion		Net Increase Due to Proposed Diversions	
		Peak Discharge CFS	Elevation MSL	Peak Discharge CFS	Elevation MSL	Discharge CFS	Elevation Feet
C. **Confluence of Tar and Lytle Creeks**	100	8437	803.54	9385	803.81	948	0.27
	50	7213	803.19	7947	803.40	734	0.21
Near 0-3 in an agricultural area.	25	6181	802.76	6733	803.03	552	0.27
	10	4962	802.14	5281	802.32	319	0.18
	5	3939	801.51	4113	801.62	174	0.11
	2	2803	800.78	2876	800.83	73	0.05
	1	1911	799.92	1944	799.96	33	0.04
D. **Highway 66 Bridge N.W. of Commerce**	100	11216	794.61	11993	794.87	777	0.26
In an agricultural area.	50	9590	794.06	10188	794.26	598	0.20
	25	8237	793.61	8687	793.76	450	0.15
	10	6652	792.95	6908	793.06	256	0.11
	5	5317	792.22	5465	792.31	148	0.09
	2	3814	791.22	3879	791.27	65	0.05
	1	2615	790.23	2646	790.26	31	0.03